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MARCH, 1933

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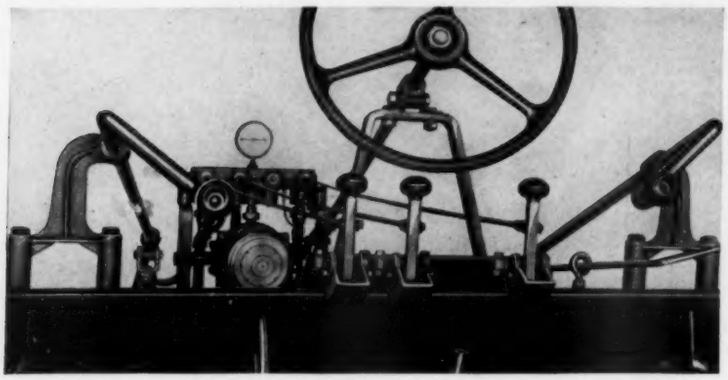

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VOL. 64 No. 3
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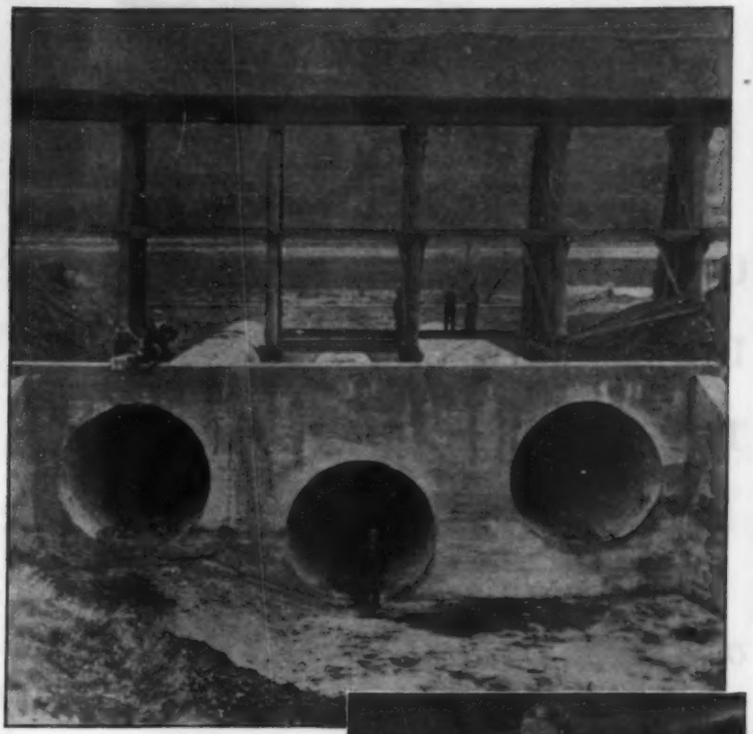

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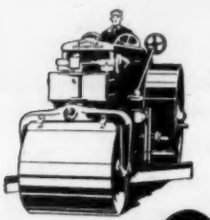

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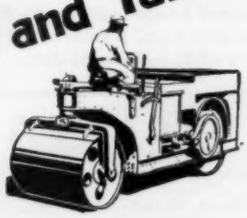

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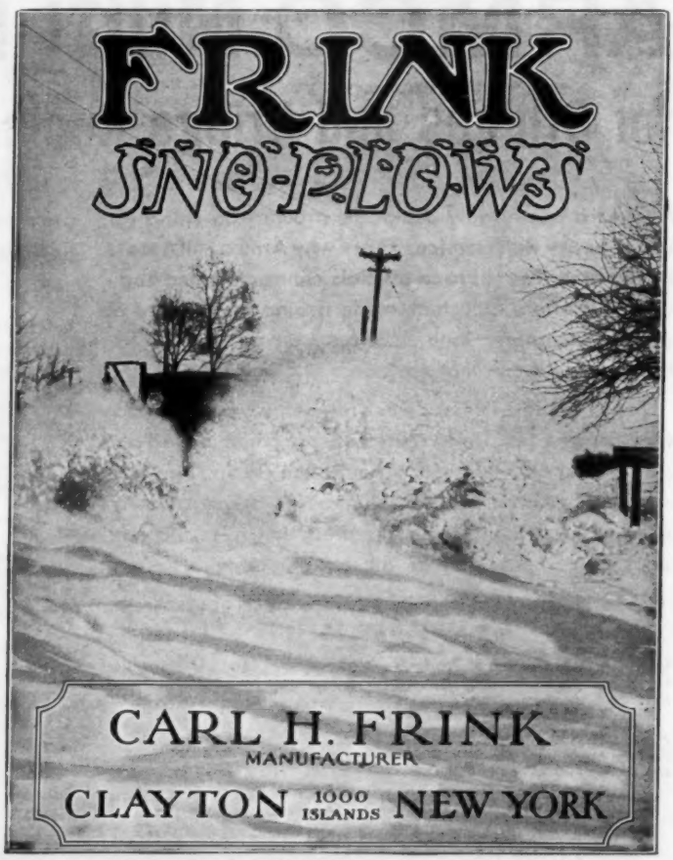

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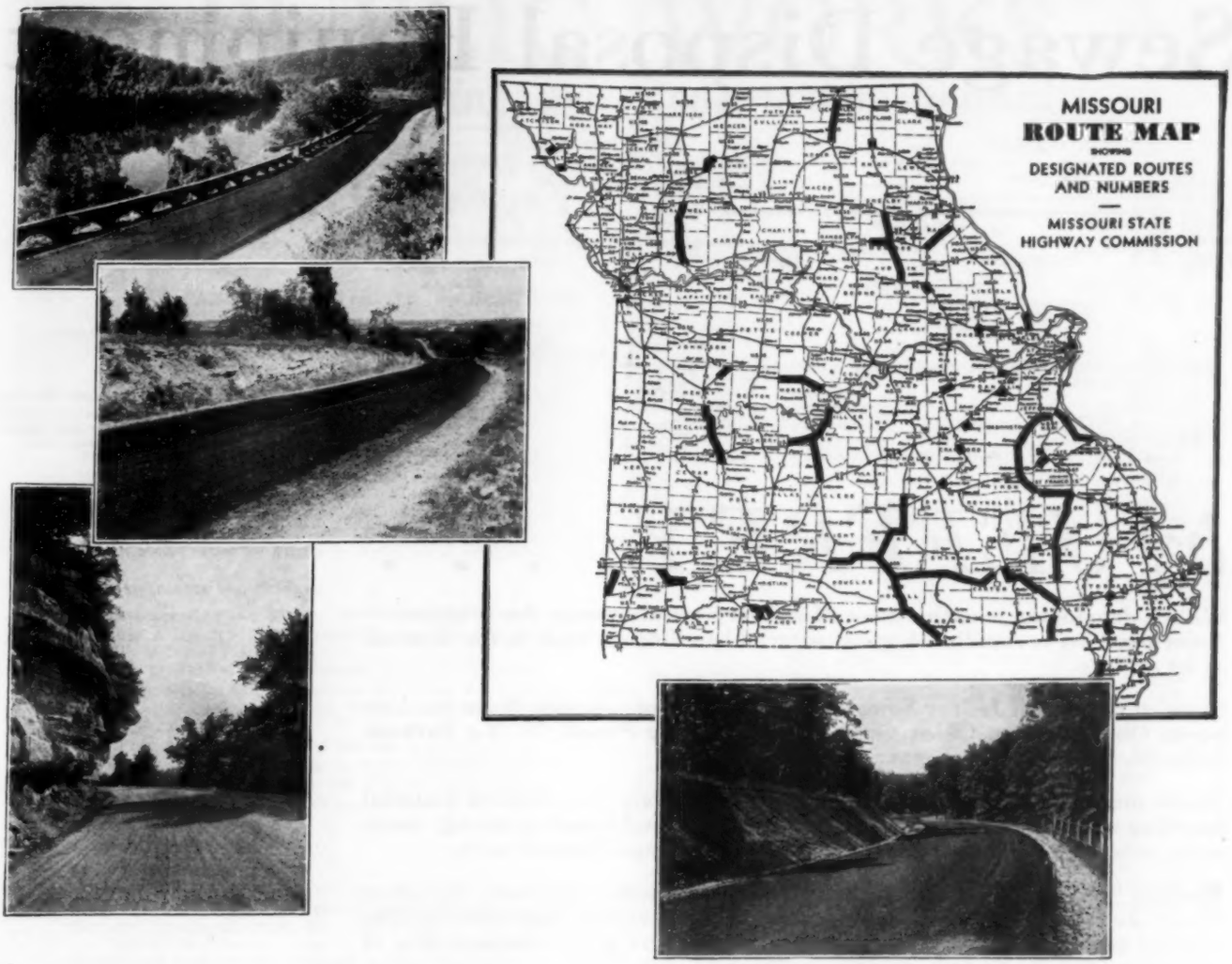

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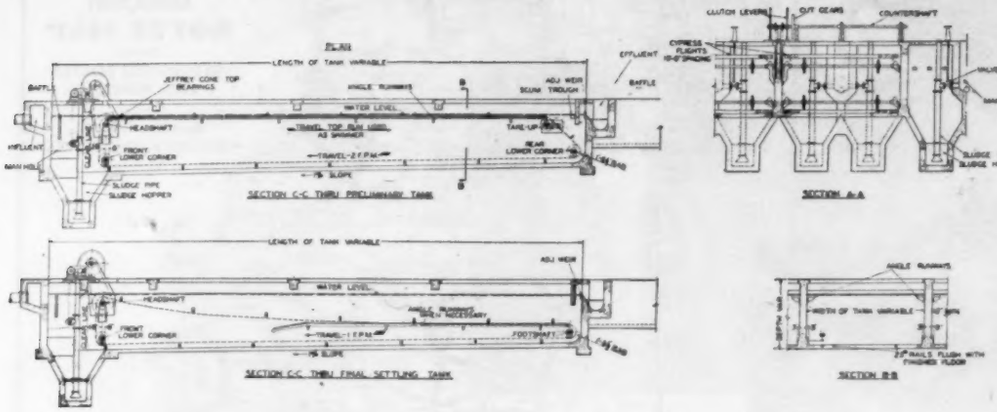

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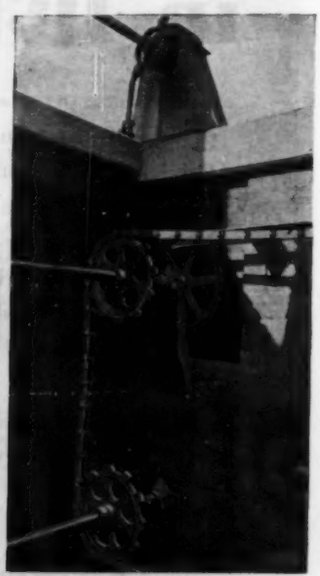
Large view (below) shows Primary Tank (looking toward effluent end) with Conveyor acting as Sludge Collector and Skimmer. Small view shows Conveyor drive mechanism at influent end of tank.



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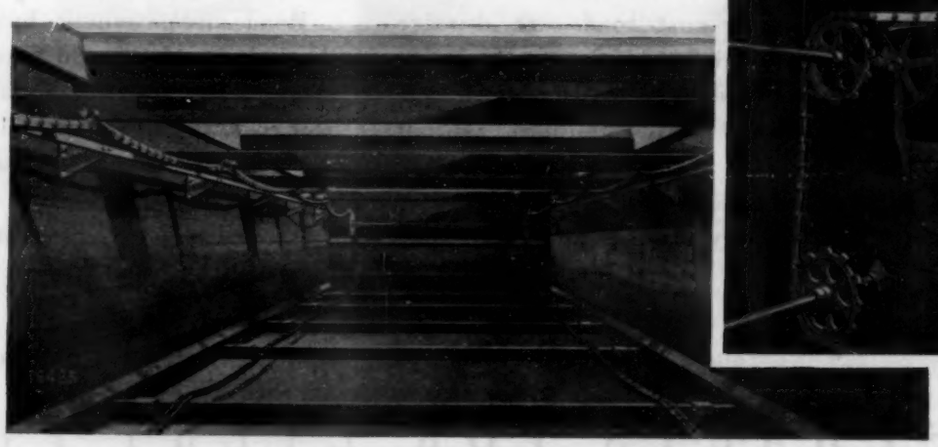

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An Engineering and Construction Journal

City County State

VOL. 64 MARCH, 1933 No. 3

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? ? ? Brainteasers ? ? ?

Mikey & Ikey & the Irish Confetti:

Mikey and Ikey and the problem were all twisted last month. The problem should read as follows: When work started in the morning, Ikey had some bricks already on the scaffold. After an hour had passed, there were still some of these bricks unlaid. Then Ikey had a stroke of ambition and brought up twice as many bricks as were unlaid, and during the next hour, Mikey laid exactly as many bricks as in the first hour. Then in the next hour, Ikey added three times as many bricks as he found on the scaffold, while Mikey laid his usual number. In the next hour Ikey brought up four times as many bricks as were left, and again Mikey laid his usual number. Then Ikey added five times as many bricks as were left; but now Mikey resolved to show what he could do, and in this hour laid as many bricks as he had previously laid since beginning for the day, and in so doing just caught up with Ikey. They were working on a 5-hour basis, and both quit at this time. How many bricks did Mikey lay in this last hour?

For the Specification Writer:

The Tensas Basin Levee District, Monroe, La., hereby, though, perhaps unwittingly, provides one of the problems for this month. In a call for bids to be submitted March 11, 1933, it asks prices on moving *wells* . . . walks . . . etc. Specifications for moving wells are omitted. Who will volunteer to write them? And further on in the call for bids, one *garage* is described as being "6 x 12" feet. Question: What size was it before the w. k. depression caused this asset to shrink?

The Sky's the Limit:

One of the latest fads is a commercial sales plan whereby each purchaser "A" is permitted and expected to make "n" sales for which he receives no commission, and then makes any number of additional sales for which commissions are paid to "A." If these additional sales are made to "B," "C," "D," etc., "A" is also entitled to commissions on the first "n" sales made by "B," "C," "D," etc. "A" is also entitled to commissions on the first "n" sales made by the first "n" purchasers from "B," "C," "D," etc.

What formula will show the total amount of earnings if a person makes "n" sales and "x" subsequent sales, each of which start successive chains without interruption (that is, each subsequent purchaser makes at least "n" sales) in such a manner that the first chain is always one step ahead of the second, the second, one step ahead of the third, etc.?

April Fool:

At a picnic, the stenographer and the office manager ran a race to a pole 100 feet away. Her steps were two feet long, and his were three, but she could run three steps as fast as he ran two. Who won the race? In solving it remember the first of April comes soon.

It seems we all got caught in the spider's web. The solution hasn't been revealed to us either through labor, a vision, or a "contrib" from a reader. SOS SOS SOS.

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Model T-33
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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 64 — *March, 1933* — No. 3

Prepare for Immediate Beginning of Public Projects That Are "Needful and in the Public Interest"

THE Senate has passed the Wagner Bill, which amends the Relief Act to permit extending loans to public projects that are "needful and in the public interest" instead of limiting them to those that are self-liquidating exclusive of taxes, and reducing the interest rate to one per cent more than the Federal bonds bring. At this writing (March 1st) the House has not passed the bill, but if it should fail to do so, the next Congress will probably remove promptly the "self-liquidating" clause, permitting Federal loans for many more public works than can now benefit by them.

Every city engineer, superintendent of water works, or other official upon whom rests the responsibility of planning for public works, should be prepared to immediately put these funds to use; unless his city, county or state be among the favored few which have no unemployed or no difficulty in raising the funds necessary to provide work for them. He should be prepared with plans, in all their details, for starting men in actual work on any public projects which those in local authority may select. Also, to inform the council or other authority what works seem to be most suitable for this purpose, and why, and how they can best be carried out to realize the chief aim—furnishing work for the unemployed which will also give the taxpayers fair value for their money in needed improvements.

Such work may include widening roads and dressing unpaved shoulders; making various improvements in parks; cleaning reservoirs and inspecting and cleaning their water-sheds; laying sewers and water mains; constructing and repairing pavements, and opening up new highways. One of the most difficult problems is providing work for the "white-collar" men and for them such jobs are suggested as painting lamp posts, trolley posts, etc.; making and erecting street signs; painting house numbers on curbs; inspecting all properties for violations of sanitary or fire laws; surveying all properties for tax assessment maps; making a leakage survey of water mains. These are only suggestions; local conditions should be studied by each official and work selected in accordance with them.

The R. F. C. will presumably make loans first to those who can present plans completely worked out, with estimated cost, and convincing explanation of why they are needful and in the public interest. And we urge all who are not prepared to do so, to make such preparations at once. On this page are given quotations from letters which we have received from public works officials, which we urge all to read.

Quotations from Letters Received by PUBLIC WORKS

"The city without definite projects already well developed is not in a position to take up its corporate obligations to its unemployed. I know of a city which had been working toward the opening and developing of a new highway to its airport for about five years. When item I of R. F. C. funds became available, plans were in sufficient detail that actual construction was commenced on two days' notice. Another highway, first proposed through the city planning commission, was undertaken on a week's notice. ***An industrial sewer election was called on two days' notice to the city engineering department,*** *and plans were completed and construction stakes driven on a six-mile project before the election carried." P. L. Brockway, City Engineer, Wichita, Kans.*

"This office with its reduced personnel, will continue to work out well defined plans for public improvements over a period of say ten years, and will be ***prepared to put such construction immediately under contract when the municipality finds it possible to appropriate sufficient funds.*** *" R. Keith Compton, Director of Public Works, Richmond, Va.*

"In periods of depression, the engineering department has carried on a program of preliminary studies and estimates of public works projects looking well in advance of the immediate needs." W. W. Horner, Chief Engineer Sewers and Paving, St. Louis, Mo.

"In our bureau, to date, there has been no reduction in our engineering force, and we have made a special effort to prepare the necessary surveys, plans and specifications for the various additions to the water supply system that we considered necessary, so that the ***contracts for this work may be let immediately following the authorization of funds*** *to cover such construction work. During the period that construction work has been very actively carried on it is ordinarily impossible to keep up with the planning of future work and also to maintain records of work performed in the manner that is desirable. Times such as these afford an opportunity to do work which we could not perform in the stress of the very active construction period." Wm. W. Brush, Chief Engineer, Bureau of Water Supply, New York City.*

"An additional water supply is urgently needed. . . . The preliminary plans for the work are in such shape that immediately upon the acquisition of the property, contracts for the first portion of the work could be let. The writer fully agrees with you that ***it is up to the engineers to be sure that plans are ready for neeeded improvements,*** *not only to provide employment for engineers but also to start public improvements that will help in the whole program of recovery." Morris R. Sherrerd, Chief Engineer, New Jersey State Water Policy Commission.*

"Although drastic reductions have had to be made in my staff in the past year, I still have a considerable force available to handle engineering duties in this city, and when it became apparent that this money could be used, I had my staff drop their work and give immediate attention to this task. Most of the projects on which this relief labor is being used had already been designed, but actual work on the projects had been postponed due to the difficulty in financing the projects. Under these circumstances, it is possible to place the men at work immediately, utilizing the plans which were already complete or sufficiently advanced to permit the grading work to be done with this relief labor." J. J. Jessup, City Engineer, Los Angeles, Calif.

Municipal Engineering an Unusual Opportunity for Social Service

By P. L. Brockway
City Engineer, Wichita, Kansas

LAWS and ordinances authorizing the election or appointment of a city engineer usually begin about this way: "It shall be his duty to establish grades on city streets, to keep a record of such grades, and to perform such other duties," etc.

The duties of the office, in other words, are quite elemental—drain the mud holes, answer complaints and inquiries about the condition of the streets and highways—maybe build a little or more pavement each year, install a few sewers, drains and culverts, and to keep the records. All of these things to be done only on request of citizens and as instructed by the legislative body of the city or the commissioner of public works. But if a city engineer performs these duties ever so well and then stops, he is little better than a trained errand boy for the administration.

Fortunately, he has it in his power to start from this essential nucleus of duties as a center and expand his service through a widening circle of opportunities. He may first of all interest himself in improving the ground control of street lines by a comprehensive, precise survey of the territory and establishing land monuments with detail maps and records. Who but an engineer will be in a position to find the necessity for such work? Contour maps in rough territory and profiles in flatter terrain will naturally follow. He now has tools with which to approach intelligently the duties of the office. These functions might be called a secondary obligation, and he is now prepared to take a step ahead of the immediate desires of his clients into a realm of advising some of them as to sequence of steps best to be undertaken in further physical development of the urban and suburban territory in which they are interested.

We call such work city planning. No one person may do much by himself, but with definite information and a lively interest in the matter, he can interest a group here and an owner there and create a respect for the office. I am persuaded that *this is where municipal engineering really begins*. At this point also the average municipal engineer will, if he is wise, recognize his limitations by asking for outside expert advice in developing his own thinking. No city engineer can know all of the principles of all the divisions of municipal engineering which confront every city of every size. Such things as designing a water-works, a sewage disposal plant, an unusual bridge or viaduct may well be outside his ability with no discredit to himself.

I shall not soon forget a comment made a few years ago by a prominent city planning consultant to the effect that very few city engineers gave him any willing cooperation in his major work of preparing city plans. How can a city engineer be of the best service to his community, as a citizen whom society has especially trained for usefulness, without a vision of its future needs? And how better can he learn those needs than by eagerly sitting in with the developing of a plan for the future by a man whose whole work has peculiarly qualified him for it? The same thing applies to other special problems. The consultant can give much better service to the city if he receives the active and enthusiastic cooperation of the local engineer, and usually at less cost to the city.

When a municipal engineer has reached this boundary line in his own development and has a city plan with a working knowledge of its possibilities, he is in a position actively to advise his boards and groups of citizens as to the opportune times to undertake each unit. Sanitary sewer systems may be built by small sections with a certainty of ultimate maximum of usefulness. Suburban platting may be controlled by legislative authority through a city or regional planning commission to avoid expensive revision of terrain for surface drainage of building sites into streets and subsurface structures. For example, within the last week an owner of a suburban tract near a city which is operating with these facilities advised the city engineer that he does not intend to build a house until the street layout has been developed and approved.

The present financial crisis has emphasized the importance of such functions of municipal engineering. The whole country is thinking in terms of made work, self-liquidating projects, etc. The city without definite projects already well developed is not in a position to take up its corporate obligation to its unemployed. I know, on the other hand, of one city which had been working toward the opening and developing of a new highway to its airport for about five years. When Item I of R. F. C. funds became available, plans were in sufficient detail that actual construction was commenced on two days' notice. Another boulevard, first proposed through the city planning commission, was undertaken on a week's notice. An industrial sewer election was called on two days' notice to the city engineering department, and plans were completed and construction stakes driven on a six-mile project before the election carried. These things are cited to bring a definite point to what has been a theoretical discussion.

This final stage of service to society is not reached in a day. It is a long road, full of discouragements and with the ever present possibility of abrupt conclusion in so far as any one individual is concerned. But the American Society of Municipal Engineers finds among its own members no lack of candidates for the Greeley Veterans Award who must have served the same community for at least twenty-five years. The satisfaction of achievement in the development of any major project is well worth the active (but not too perniciously active) promotion period of five or maybe ten years. The interesting thing is the almost lightning shift in our complex society which is very apt to provide a receptive opening for a project which has been stowed away in the background of the mind of a municipal engineer and in the files of his office for years. Who, for example, could have foretold a year or two ago that nation-wide made work would become such an agency?

Leveling asphalt base by bringing up low spots and cutting down high ones

Resurfacing Newnan Streets With Brick

By J. E. Gilbert
Street Superintendent

THE most heavily travelled streets of Newnan, Georgia, are those which form a part of the state highway running north and south through the town. These were paved twenty years ago with three-inch penetration macadam, except for the court house square which had previously been paved with three-inch wood block. Brick also had been laid on some of the other streets more than twenty years ago.

By 1930 the state highway streets had deteriorated to such an extent that the surface was rough and uneven and the maintenance cost prohibitive. After several unsuccessful attempts to obtain the cooperation of the state highway department in repaving these streets a plan was presented in 1931 which was accepted. This plan called for resurfacing the old pavement with 3-inch wire-cut lug brick on a ¾-inch sand cushion laid on top of the old penetration macadam (after leveling this up) and in place of the wood block; the town to furnish all labor and transportation and the state to supply brick, filler, sand and materials for leveling up for a 20-foot width only. Brick was chosen by the town because that material had been in use on some of its streets for more than twenty years and had cost nothing for maintenance and had otherwise proven satisfactory, and still gave promise of an indefinite number of years of like service. The penetration macadam would be brought to an approximately smooth surface by use of tar cold-mix material. The filler was to be asphalt of 30 to 60 penetration.

Part of the curb along these streets was concrete integral with the gutter, and it was planned to use 2½-inch brick and ½-inch cushion on top of the concrete gutter, thus reducing the 6-inch curb height to 3 inches.

This design at first was considered impracticable by some of the highway department engineers but was approved by B. P. McWhorter, state highway engineer.

The highway officials at first proposed scarifying the old macadam in bringing it to a uniform surface but fortunately reconsidered and left it undisturbed. For leveling up the low spots, a mixture of tar and ½" to 1" crushed granite was used; tar because it sets more quickly than cut-back asphalt; small-size stone because this is better for filling the shallower depressions and provides a dense surface to prevent the cushion sand from sifting through. This cold-mix material was rolled with a 4800-pound roller drawn by six men, which gave the same unit compaction per inch of width as the larger power rollers.

At some places, and especially where the 3-inch and 2½-inch brick and reducing the sand cushion to the minimum left 3 inches even at the lowest places. There was greater depth than was necessary. By these means the surface was brought closely parallel to the finished grade, so that no material variation in thickness of sand cushion was necessary.

Gutters. The curb varied considerably in height but was generally 6 inches above the gutter, and the use of 2½-inch brick and reducing the sand cushion to the minimum left 3 inches even at the lowest places. There was some doubt as to the adequacy of this height to carry the gutter water, but it has now carried extremely heavy rains even better than before because the brick gutters are smoother than the old ones, being laid longitudinally for this purpose.

Where the 3-inch and the 2½-inch brick came together on a uniform surface, the cushion under the former was reduced to about ¼ inch and that under the 2½-inch brick increased to ¾ inch.

At street intersections adjustments of grade were made by use of cold-mix materials carried from the face of the brick paving out the intersecting street to a feather edge.

Opportunity was taken to correct cross surface drainage at street intersections and driveway entrances, to increase the capacity of storm sewer intakes, better the condition of manholes, and lay new and more permanent types of water pipes and connections. All openings made for these improvements were backfilled and tamped in 6-in. to 8-in. layers.

Sand Cushion

For the sand cushion, screened bank sand with about 8% loam was used, this amount of loam being desirable for securing proper compacting and prevention of shifting.

As the width of the streets made it impossible to use a full-span template, the following method was employed: Previous to spreading the sand, the engineer gave elevations at 50-ft. intervals longitudinally and about 7-ft. transversely each indicated by a brick set on a mound of sand. This, in a 50-ft. pavement, would place an elevation marker at the center and each quarter and eighth point and each curb. Midway between the 50-ft. rows an intermediate transverse row of grade bricks was placed by stretching a cord tautly in a longitudinal direction between the tops of the bricks already set. In the same way, two more transverse rows were placed, giving rows at 12½-ft. intervals.

Sand was then spread loosely over the base as nearly to the desired depth as could be estimated. Then a brick was drawn through the sand beneath a cord stretched tightly between each pair of elevation bricks, and the sand leveled off to the surface so indicated, and rolled with a hand roller weighted with water. An experienced lute man then readily brought the entire cushion to the exact elevation; and a remarkably smooth brick surface testifies to his success.

Laying Brick

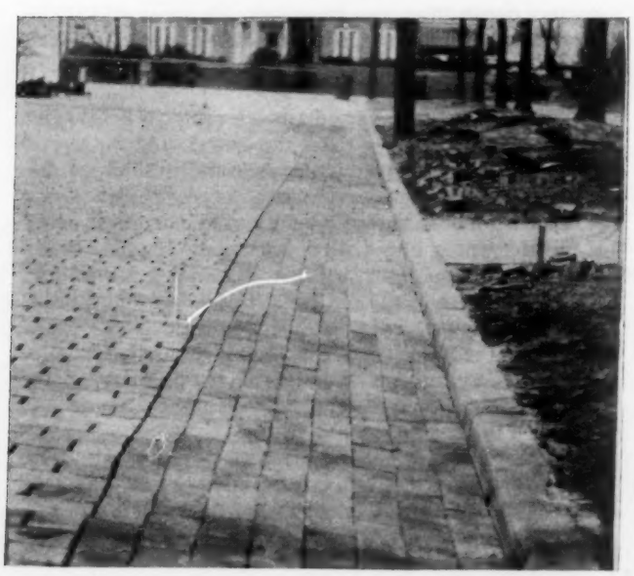
The brick was furnished by the Southern Clay Manufacturing Co. of Chattanooga which supplied a competent superintendent resident on the job free of charge, also small tools and equipment and assisted in securing competent sand bed men and brick droppers. These were unusually efficient, one dropper, assisted by untrained labor, having placed nearly 49,000 brick in a 9-hour day.

Unusual care was exercised in obtaining straight lines between the rows of brick and while no extra time was spent in securing this alignment it was watched carefully for the slightest deviation. A 2x4 six feet long placed against the line of brick and hit with a hammer was the only method used in aligning the rows. "Dutchmen" were placed where necessary to adjust for curvature. Some of the intersections were laid herringbone.

After the brick had been dropped and the pavement swept, the culls were replaced and the pavement rolled with a 4800-pound roller. If any deviation was found greater than a quarter inch under a 10-foot straightedge, brick were removed from the faulty spot, the cushion adjusted, the brick replaced and again rolled.

The joints were filled with Texaco No. 39 filler, about 12 pounds per square yard being used for 3-inch Dunn wire-cut lug brick. In pouring, a wheeled squeegee buggy was run transversely across the pavement, overlapping a half-width each time, and then was run longitudinally not overlapping. This was followed by a hand squeegee to take care of any excess filler. As the weather was somewhat cool, care was taken to leave the joints about an eighth to a quarter short of being filled, and last summer the joints were filled but there was practically no bleeding. Sand was cast on the surface immediately after squeegeeing to take up the excess filler. Only a very thin layer of filler was left on the surface and this disappeared rapidy under traffic.

On this job J. W. Lovell was resident engineer for the highway department and Phillips Moore inspector. The writer was in charge of construction for the city, under Frank Stripling, chairman of the street committee. T. J. O'Neill was furnished by the brick company in an advisory capacity.



32-inch gutter, using 2½-inch brick

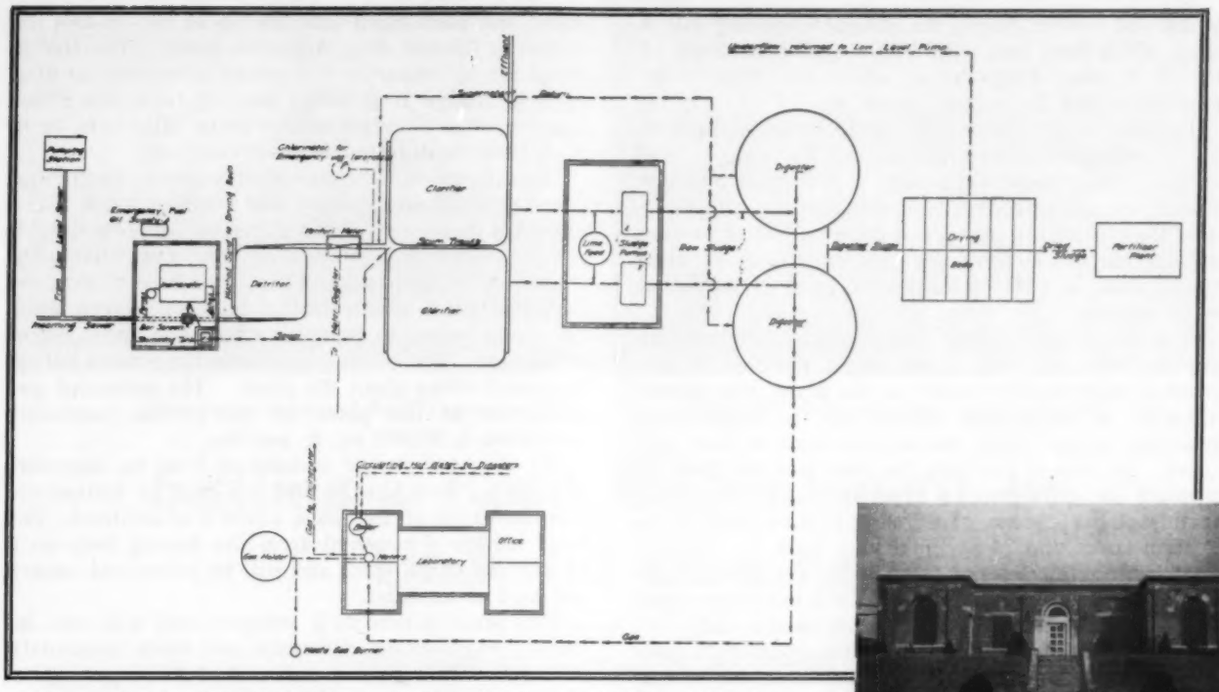
Activated Sludge Patents

Four United States patents were granted to an Englishman, Walter Jones, in 1917, 1918 and 1921 covering features of the aeration of sewage by introducing air through porous bodies in the bottom of a tank in such a way as to cause circulation of the sewage, and apparatus for accomplishing this; and introduction of sludge into the sewage during aeration, and reaeration of the sludge. The patentee, Jones, is dead and the patents are owned by Activated Sludge, Inc.

In 1912 Dr. Gilbert J. Fowler visited the Lawrence, Mass., Experiment Station, saw there the work being done by Clark in the aeration of sewage, and on returning to England he and Jones conducted experiments which developed into a method involving the circulation throughout the sewage of sludge particles bearing aerobic bacteria, and filed applications for British patents thereon in 1913 and 1914.

Experiments along similar lines were being conducted in the United States from 1913 on. In 1914 Milwaukee began its extensive experiment, which resulted in its adoption of the activated sludge process in 1917 for its plant which was completed in 1925.

On Feb. 7th, 1933, Judge F. A. Geiger, of the U. S. District Court of Milwaukee, handed down his decision in an infringement suit brought against Milwaukee by Activated Sludge, Inc., and tried in May, 1929, but held under advisement by him until now. In this he holds that the patents were valid and that Milwaukee has infringed them. The city intends to appeal the case to the Circuit Court of Appeals, which will delay final decision for further months or years. A similar action was brought against the Sanitary District of Chicago, but a continuance was granted and repeatedly renewed and the case is scheduled to be resumed on April 3rd.



General layout of the Ensley plant. At the right, the main building of this plant.

Up-to-Date Sewage Treatment Plants in Jefferson County, Alabama

By H. H. Hendon

County Sanitary Engineer, Jefferson County, Ala.

AT the beginning of 1932 Jefferson County, Alabama, had a capital investment in sanitary sewers and sewage works of approximately $1,200,000, serving a total area of 140 square miles, with about 400,000 population. At that time the original sewage treatment plants, built during the previous thirty years at Ensley and Bessemer, were grossly overloaded and obsolete, and plants to serve two other districts were needed.

A construction program to extend over four years was prepared, under which project No. 1—a 15 m.g.d. primary treatment plant at Ensley—has now been 90% complete; bids for No. 2—the first units of a 20 m.g.d. plant at Bessemer—were received on Jan. 31st, 1933. The designs for project No. 3, which will be built in 1934, and projct No. 4, to be built in 1936, have not been prepared yet.

Project No. 2 will consist of bar screens, cleaned by an electrically operated raking mechanism controlled by a time clock, the screenings to be buried; a venturi-type sewage meter, and an office.

In project No. 3 it will be necessary to carry the treatment to a very high degree with a plant capacity of 3 m.g.d. A 42-inch main is now being built to serve this district, an unusual feature of which is that approximately 1¼ miles of it is being laid with especially designed 42-inch cast iron pipe that cost only 12% more than concrete pipe. This iron pipe is parallel to and about 100 ft. from a lake and below its water level, and it is believed that its use will materially decrease treatment cost.

Project No. 4 probably will be a 5 m.g.d. separate sludge digestion, sprinkling filter plant.

Sludge beds.

Detritor under construction.

The Ensley Treatment Plant

Project No. 1 will treat the sewage from an area of 39 sq. mi., which was formerly treated by means of settling tanks, digestion

tanks, and contact filters, the effluent emptying into a creek which flows into a 3.5 billion gallon reservoir of the U. S. Steel Corporation, which uses from it 40 m.g.d. of water for cooling, steam, etc.

In the new plant practically all of the incoming sewage is reclaimed as some by-product. The sand is used on the drying beds; the sludge is converted into fertilizer; the gas collected from the digestion process is used throughout the plant; and the water, after passing through the impounding reservoir, is used by the Steel Corporation as part of the source of their industrial water supply.

The plant was designed for 15 m.g.d. Preliminary studies indicated that if the major portions of suspended solids were removed at the plant, the natural agencies of purification offered by the impounding reservoir would handle the organic load without nuisance. In view of this fact, the plant was designed for primary or sedimentation treatment only, consisting mainly of bar screens, grit tank, 2 settling tanks, 2 digestion tanks, and 24 sludge drying beds.

The incoming sewage flows under the screen house floor, through a rack or screen with 1-inch clear openings. As the screenings accumulate on this rack, they cause a difference of head which actuates an electrically driven cleaning mechanism, which delivers the screenings automatically into a trough, where the free water drains back into the sewer. These screenings are then hand-stoked into an incinerator, where gas from the sludge digestion tank is used for fuel. This incinerator is also arranged to use oil for fuel in case of an emergency.

A unique feature of this plant is that the suction of the blower supplying air to the incinerator is connected to the top of the incoming sewer immediately up-stream from the opening in the top of the sewer through which the screen mechanism works. This blower will exhaust into the incinerator the foul fumes traveling down the sewer.

The floating scum from the settling tanks is pumped to the screen house, where it is mixed with the screenings and incinerated.

The sewage flows from the bar screen into a square grit tank, equipped with a mechanism for removing and washing the grit, which is used to replace sand on the sludge drying beds. Immediately following the grit tanks is the main sewage meter of the venturi type.

The sewage next flows into two 85-foot square by 11½-foot deep settling tanks and from these tanks into Village creek, with provisions for chlorination if it should become necessary. The solids that settle in the tanks are swept to the center by a cleaning mechanism and are drawn off as sludge by two plunger-type sludge pumps and discharged into the top of two 75-foot diameter by 23-foot deep digestion tanks. The sludge pumps are so connected that either pump may be used to pump sludge from either settling tank into either digestor, or to circulate sludge in the digestors, or to pump from the digestors to the drying beds.

These digestion tanks are equipped with mixing and scum-breaking mechanisms and heating coils. The tanks are covered, and the gas given off is collected, passed through drip pots and metered, and delivered to a 5,000 cu. ft. gas tank. This gas is used to heat the digestion tanks, administration building, screen house and pump house; to burn the screenings and for laboratory use. The excess gas is burned in a waste burner to prevent odors about the plant. The estimated gas production of this plant for the present connected population is 90,000 cu. ft. per day.

The digested sludge withdrawn from the digestors is a heavy, thick sludge and is piped by hydrostatic pressure to the drying beds, where it is air dried. The dried sludge is removed from the drying beds on a 24-inch industrial track and will be pulverized, sacked and used as fertilizer.

This plant is now 90% complete and will cost, including engineering, driveways and other incidentals, $175,000. This gives a unit cost of $1.35 per capita. Unit costs of the major items of this plant are as follows:

Settling tanks 28c per effective cubic foot
Digestors, 24c per cubic foot of digestion space.
Drying beds, 28c per square foot of area.

The cost of operation is estimated at 16c per capita per year. These are remarkably low unit costs, being far below the cost of similar projects elsewhere.

At the recent Highway and Building Congress, in Detroit, S. A. Greeley, of Chicago, in a paper "Sewage Disposal Costs," gave the unit construction cost for plants at Grand Rapids, Mich., and Peoria, Ill. The settling tanks, digestion tanks, and drying beds are of the same type as the Ensley plant in Birmingham, and are taken as recently built representative plants of this type.

The comparative unit cost of these two plants as compared to the unit cost of the Ensley plant at Birmingham, and the unit cost at Birmingham expressed in the percentage of the unit cost of these two plants, is given in the following table:

	Grand Rapids Mich.	Peoria Ill.	Birmingham Ensley Plant	
Digestion space per effective cu. ft...	.44	.30	.24	65%
Settling space per effective cu. ft...	.54	.60	.28	50%
Drying beds per effective sq. ft. ..	.38	.33	.28	79%

This plant was designed by the writer, and after completion was checked and approved by Fuller and McClintock, consulting engineers. Christie, Hutchinson & Burton, Inc., of Birmingham, are contractors.

Settling tanks.

Gas holder.

Pouring digester tanks.

Ditch blast at the toe of the fill slope.

"Underfill" shots were wired up after the ditch blast.

Settling a Road Embankment by Underfill Blasting

By Carl G. Wahl

Resident Engineer (in Charge), Ohio State Highway Dept.

IN THE northwest section of Ohio there are quite a number of so-called swampy areas through which new road locations must pass. One of these roads, Route No. 49 north of Hicksville, Defiance county, built last year, had to cross about 800 ft. of one of these swamps. There was some question as to just how the embankment here should be handled, and therefore it was built to grade and left until the balance of the project had been completed with the concrete laid up to each side of the swamp.

The unstable material varied in depth from 6 to 22 ft. and consisted of a mixture of peat, muck and soft blue clay. Various means of securing the necessary foundation were considered, and it was decided to follow out the instructions agreed upon by Professor F. H. Eno, of the Cooperative Subgrade Survey, Ohio State University, and L. F. Livingston, fill settlement expert of the du Pont Company, and approved by Elmer Hilty, chief engineer of construction for the Ohio State Highway Department. The work was carried out by J. H. McBlain, of the du Pont Company, and Fred I. Rowe, of the W. L. Johnston Construction Company. The result was satisfactory in every respect.

The use of explosives in fill settlement work is one of the most interesting and valuable developments in highway construction practices in recent years. In general, such operations come under three heads—trench blasting, underfill blasting, relief blasting.

Trench blasting is used where the unstable material is less than 10 ft. deep, and where there is no fill in place previous to the blasting work. The exploding dynamite throws out the unstable material, leaving a large trench to be filled in with stable fill material.

Underfill blasting is used where the fill is already in place. This may be partly an old floating fill, or may be wholly a new embankment. Sand, gravel or any free-flowing material is ideal for an embankment that is to be settled by this method. Dynamite is placed in the unstable material under the fill in single, double or triple rows, depending on the local conditions.

Relief blasting is mostly used where the fill has been in place for a long time, or is of clay, so that a decided bridging effect has been set up within the fill, making it essential to attempt to drop the fill as a solid block rather than depending on the flowing quality of the embankment material to settle into cavities made by underfill blasting. Large ditches are blasted on either side of the embankment, thus relieving the pressure on the unstable material so that the weight of the fill can readily push the muck from underneath.

In connection with the work on Route No. 49, it is to be noted that one of the main features of the underfill method of shooting is to be sure to have a sufficient amount of super-fill placed before any blasting work is done. The depth of this fill should be equivalent to the depth of the unstable material. Therefore, a 10 ft. super-fill was placed above the level of the required grade. Three lines of holes were made along the top of the fill, the center line on 10 ft. centers, and the two outside lines, which were 10 ft. from the center line, on 20 ft. centers. These holes were made by driving pipe, mostly 3½ inch inside diameter, through to hard bottom. Old second-hand pipe was used and was left in place rather than to go to the expense of pulling the pipe each time after the load was placed. A rather unique system was used in putting down the pipe. Post-hole diggers were used to make the holes through the fill; then the pipe, with a wooden block in the lower end, was put in place and could usually be pushed for several feet into the unstable material, and wooden mauls were then used to drive it to hard bottom. Had a portable pile driver been available, the expense of putting these holes down would have been materially lessened, but even this cost was not excessive.

Forty per cent gelatin dynamite was used in cartridges 3″ in diameter and 10″ long, which size allowed the cartridges to slide down the pipe. The outside rows of holes were loaded with 20 to 35 lbs., and the center line was loaded with 35 to 60 lbs., depending upon the depth of muck at that particular location. Wherever 50 lbs. or more was used it was necessary first to spring a hole in order that the dynamite be concen-

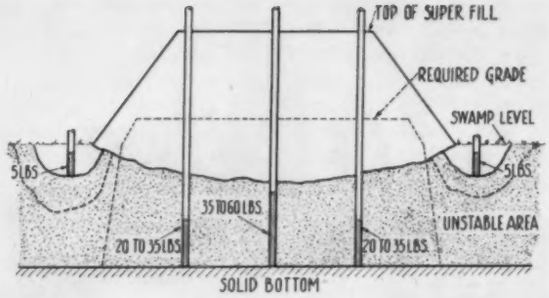
trated rather than come up too far in the pipe. A pound of dynamite was used as a springing charge, and this opened up the lower end of the old pipe so that the required amount of dynamite could be placed in a compact space. A total of 4,900 pounds of 40% quarry gelatin was used on the underfill shots.

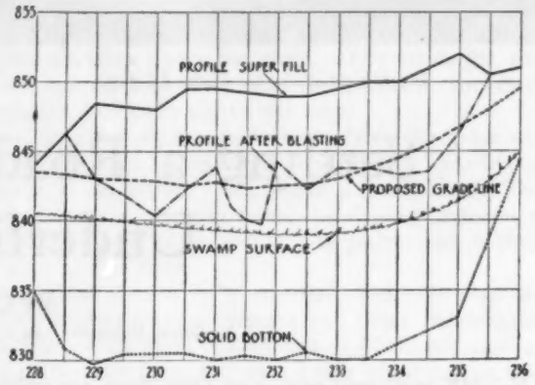
The work was done in the middle of the summer, and the top 4 ft. of the swamp was quite dry and hard. It seemed essential to break up this 4 ft. of material between the toe of the slope of the fill and the surrounding swamp surface. It was therefore decided to blast a ditch along the toe of each slope in order to stop any bridging effect and give the unstable material under the fill a better opportunity to get out at the sides. Had the work been done in the spring of the year these side ditches would have been shot by the propagation method, but because there was not enough moisture to carry the propagation wave, it was necessary to put an electric blasting cap in each hole. Five pounds of ditching dynamite was used every 5 ft. along the toe of the slope, using a total of 1,350 pounds.

The underfill holes in the three rows were loaded first and the wires coming from the electric cap in each hole were laid out so that they could be wired up quickly, then the side ditches were loaded and shot separately. If they had been shot together, the two blasts would have a tendency to throw more material on top of the fill and cause more trouble in wiring up the big shots. As soon as possible after shooting the ditch shots, the underfill holes were wired up and fired. The reason, as stated before, was to give every opportunity for the underfill shots to push the material through the weakest point, which was at the toe of the slope.

A short section was shot first, somewhere near the center of the fill. This shot gave very satisfactory results. The engineers, immediately after the shot, took borings, and found that the center of the fill was practically on hard bottom. The balance of the work was completed in two sections, one on either side of the trial shot. Some of the spectators who saw the road after the fill had gone down, said that it looked more like a big ditch than like a piece of highway, but they could not find where the fill had been moved to. This so-called big ditch was leveled up, the road brought up to grade and a gravel surface put in place. It will be allowed to compact until next spring, when the concrete will be laid.

Mistakes have been made in the past in connection with the settling of highway fills, in that the concrete has been put on too soon. A fill settled with dynamite may show by borings that it is resting on solid ground, but if it be 20 to 25 ft. thick, that fill, or any other fill, will require considerable time before the compaction of the material within the fill is entirely complete. This is the reason for the delay in laying the slab on this particular section. Very complete sounding records have been and are being kept by the Ohio State Highway Department so that the action of the fill and the movement of the unstable material beneath will be thoroughly understood.





Above—Three center lines of holes loaded with 40% quarry gelatin dynamite, then two ditches shot with ditching dynamite. Below—Series of profiles showing the super-fill before and after the blast.

Fill Settlement Bibliography

In addition to the articles that have appeared in PUBLIC WORKS on the subject of *Fill Settlement by Explosives,* the following articles have appeared in other technical journals:

Scientific American	Nov. 1932	Pages	9-10
Explosives Engineer	Aug. 1931	"	114-115
Engr. News Record	Sept. 1930	"	329-334
Engr. News Record	May 16, 1929	"	788-791
Roads and Streets	April 23, 1931	"	687-689
Motor Club News	April 1931	"	139-144
Public Roads Magazine	July 1931	"	17
Pacific Street and Road Builder	Feb. 1927	"	233-239
DuPont Magazine	Nov. 1931	"	13-14
The Earth Mover	Oct. 1931	"	4-6
Engineering and Contracting..	July 1932	"	16
Highway Engineer & Contractor	June 1932	"	149-150

Amer. Road Builders Assn.—Bulletin 17.
Use of Explosives for Settling Hwy. Fills (DuPont) Bulletin.
Accelerating Swamp Fill Settlement with Explosives—(Hercules) Bulletin.

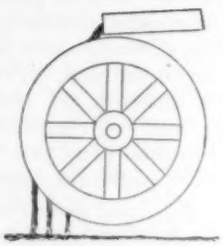
These were furnished us through the courtesy of L. F. Livingston, Manager, Agricultural Extension Dept., E. I. du Pont de Nemours & Co.

The "underfill" shot.

Result of the "underfill" shot.

THE WATER WHEEL

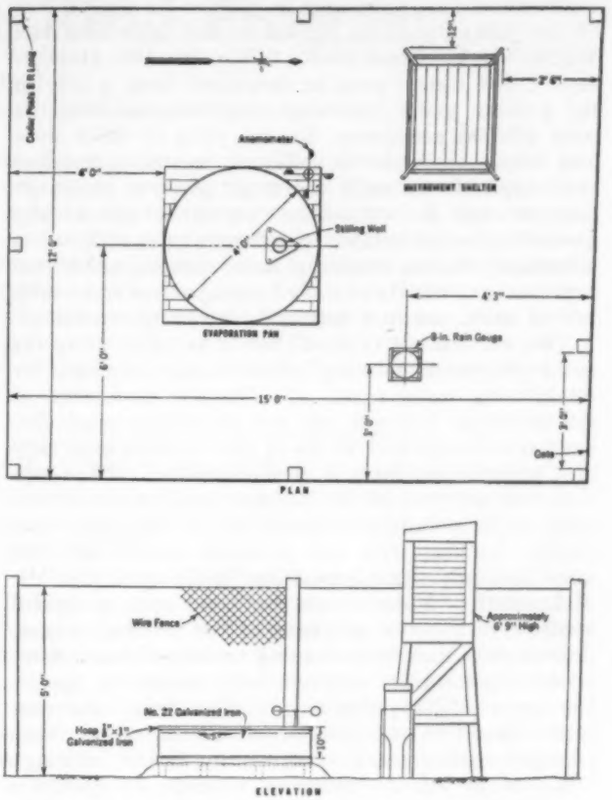
FOLLOWING are the essential features of the important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted. Published every month to include articles appearing during the preceding month.



EVAPORATION from water surfaces is an important element in the calculation of the sufficiency of storage reservoirs, especially in sections of the country where evaporation rates are high and precipitation low. The wide variation is indicated by records of average annual evaporations of 123.67 inches in Atbara (Egypt) and 14.29 in Ontario. In the United States records vary from 17.54 in Menasha, Wis., to 97.10 near Salton Sea, Calif., with a monthly maximum of 13.10 inches. A study of evaporation has been made by a committee of the Am. Soc. of Civil Engineers which adopted as one of its primary objects the finding of "a suitable set of coefficients by which the great variety of existing data on evaporation could be corrected, to the end that evaporation from a large water surface could be expressed in terms of that from the various types of pans in use." Results from five types of pans are considered, and Carl Rohwer concludes[41] that "Records from floating pans are not as consistent or reliable as landpan records; nor is the evaporation from a floating pan any nearer the evaporation from a large water surface than that from a sunken pan of the same size and shape." Actual evaporation from reservoirs is affected[42] chiefly by elevation above sea level, air temperature, relative humidity and wind velocity.

The committee recommends[43] the use of the U. S. Weather Bureau Standard Class A land pan as the most reliable, to the results of which should be applied a coefficient of 0.70 (reasonable range = 0.60 to 0.82). A gauge for measuring evaporation and a standard Weather Bureau rain gauge are essential, and it is desirable to use also a recording anemometer; a set of maximum-and-minimum thermometers for air temperature and another set for water temperatures, and a sling psychrometer.

Specification writing was the subject of two papers in the A.W.W.A. Journal; Julian Hinds discussed the writing of construction specifications[27], and Wm. E. Stanley, specifications for filter construction[26]. The former recommends the use of accepted standard specifications as far as practicable, referring to them rather than copying them into the specifications. Also "borrowing clauses is no doubt the safest way to proceed in the writing of a specification." Happenings and



Plan of U. S. Weather Bureau Class A Land Pan

law-suits of the last few years are recalled by the statement: "Generally, all conclusions drawn from studies of data should be excluded from the specifications. . . . The opinions of expert advisers on geological, physical and legal matters must at times be furnished to the bidder, but this is best accomplished by making available to him special signed reports, outside of the specifications. Any direct expression of opinion by the owner or his agent in the specification itself may cause embarrassment." "Insofar as practicable, it is preferable to specify results rather than means of producing results."

Mr. Stanley states that, in the early history of filter construction, specifications for filters were generally of the brief descriptive type indicating the general kind of plant desired; but most modern filters have been built under extended or complete specifications covering in minute detail the quality and the quantity of materials to be included, the quality of workmanship, the exact type and character of every item required in the plant. The latter are to be preferred, for reasons explained by the author; and he tells briefly what they should cover, with many useful suggestions. Concerning the selection of manufactured equipment, he says that the "more desirable method is to require and to specify, with considerable exactness, the functions to be performed by each device, including limiting degrees of accuracy, and also require that all such equipment be subject to approval before installation and subject to test after erection." Filter control equipment, chemical feed and sterilization devices, filter sand and gravel, are among the major construction items which he discusses.

Water rates discussions by engineers and water

works officials are prominent features of the latest issues of the Journals of the American and New England Water Works Association. While, as Mr. Haskins says[24], dirt cannot even be excavated from a hole in the ground, under favorable conditions and with the most efficient machinery, for the price at which pure and wholesome water is collected, treated and delivered, available instantly and at all times, in quantities large or small, to the consumer"; in spite of which many governing bodies hesitate to authorize rates sufficient to adequately finance municipal water systems, which "except for the relatively enormous taxing power and wealth behind them, are in a hopelessly bankrupt condition."

This often is not realized, for "it is a rare thing for municipalities to make any scientific study as a basis for establishing water rates. . . . There is no feature of the municipal business that will provoke so much discussion and argument as one of rate revision, especially if it becomes necessary to raise the rates.[22] The adoption and approval of an unbiased and impartial rate study and investigation made by an engineer thoroughly familiar with rate problems would, however, meet with only slight opposition, in the opinion of Mr. McDonnell. "Rates should be based upon a careful study, over a period of years, of the revenue, income, depreciation, and the increasing amount of funds needed for replacements and constantly increasing operating costs." Changes in any of these items, occurring later, should be reflected in revision of rates. Such changes usually cause an operating deficit, although "cities enjoying the increased economy of operation through Diesel oil engine power have found it possible to revise rates downward."[22]

Comparison of rates with other cities is unsatisfactory and unenlightening unless all differences of conditions and practices are allowed for; one may have abundant water near at hand, another have to go scores of miles for it; in one city water main extensions, betterments and enlargements are paid for out of rates, in another by taxation or assessment. "It is hardly possible to establish any fair schedule of water rates without first establishing a meter system." Lower rates to large users are justified, but not less than the cost of production; and there should be a minimum rate sufficient to cover the fixed charges of maintaining a service. There should also be an income from fire protection, both public and sprinkler, and from water for sewers, street flushing, parks, irrigation, etc. From 30 to 70 percent of a plant is assignable to fire protection service, and overhead charges used in establishing the rates should recognize this; public fire protection being paid for by taxes and not by rates.

In determining the amount to be charged for public fire protection, this may be in the form of hydrant rental, of charge per mile of pipe, or charge per inch-foot of the pipe distribution system, with allowance per hydrant for maintenance in the two last. The inch-foot basis is much preferred by Frank J. Gifford.[15]

Provision for expansion must be made in all water works systems, an average of about $1.50 per capita per year being so spent.[23] This can be provided by sale of bonds or by fund created from current earnings. Both cost exactly the same, but Mr. Howson prefers the latter, as offering "the most practicable method of having funds available when needed and of avoiding delays and complications arising from bond issues, and the method of financing most acceptable to the consumers themselves." This is facilitated by a construction policy and program for orderly expansion, with the cost of each step estimated and expenditures so distributed as to effect a relatively uniform annual demand for funds.

Undeserved criticism of water works officials is not confined to the United States. The engineers and officials connected with the construction of the Glenmore dam for Calgary, Canada, last October asked a justice of the Supreme Court of Alberta to investigate criticisms of their conduct made by citizens, and he reported[5]: "I am unable to discern any single act which was not done in good faith, or which was not done in the exercise of what was at the time a sound judgment." The principal criticism seems to have been due to the cost of the dam, $704,617, being $292,000 more than the estimate, due to the fact that the bore holes sunk to learn the condition of the rock failed to reveal its true condition, and when the actual excavation was made additional depth was found necessary.

Activated carbon in powdered form should "be maintained in contact with the water for appreciable periods of time and preferably for some time on the beds," in the opinion of Chas. R. Cox."[14] Therefore, if there are no effective mixing basins in which to stir the raw water, it is wasting carbon to apply it to the raw water because most of it will settle very quickly in the first portion of the coagulation basin." In the Richmond, Va., plant carbon was first applied to the raw water about ten minutes before the coagulant,[14] but this was found to require about ten times as much carbon for taste and odor removal as when it was applied to the water immediately before filtration, but the latter reduces the length of filter runs and gives less stable deposits in the settling basins. Mr. Enslow suggested supplying part of the carbon at each point. At Rahway, N. J., large doses are applied midway between the two coagulation basins. At Ossining, 12 to 20 lbs. of carbon is applied with the alum just ahead of the mixing tank, with a saving of 40 to 80 lbs. of alum in treating water that has a color of 50 to 90 p.p.w. If 12 lbs. of carbon at 8 cts. saves 40 lbs. of alum at 4c., there is a saving of 64 cts. for chemicals. Robert Spurr Weston reported a case where 4 lbs. per million gallons of activated carbon was a great aid in removing odors and tastes and aided coagulation in a highly colored, very clear water.

Aeration is advocated by Herman Anderson,[16] for increasing coagulating efficiency as well as for removing tastes and odors, reduction of carbon dioxide and hydrogen sulphide gases, oxidation of ferrous iron and manganese, and increasing oxygen content. He described a device for blowing diffused air into the water.

Mechanical mixers for mixing chemicals with water are classified by R. S. Rankin[17] as non-mechanical—around-the-end or under-and-over type of baffled basin, hydraulic jump or spiral flow; and mechanical, employing air agitation, vertical shaft paddle or horizontal shaft paddle. He considers that the baffle types are not reliable as to velocities produced and absorb too much head; the hydraulic jump gives too short contact, the spiral flow is contrary to all theory. Air agitation has advantages but is uneconomical for large plants. He then describes the horizontal paddle type which was developed by M. C. Smith at Richmond, Va.,[37] where, comparing nine months of 1932 since use with

(Continued on page 40)

A Farm-to-Market Road Program

By L. O. Marden,
Engineer of Worcester County, Massachusetts

THERE are in Massachusetts 150,000 people living on about 25,600 farms having a total value of $261,222,390, and a crop acreage of 474,167 acres producing crops having an annual wholesale value of $31,000,000. It is fair to assume that 21,500 of these farms abut dirt roads. These farmers have paid taxes year after year but, although state and secondary highways have been built that speed them to market, they have received little if any aid on their back roads. In Worcester county about $177 per mile is provided for maintenance of dirt roads but this amount is entirely inadequate. About $500,000 per year has been spent on town-center-to-town-center roads but it would take 50 years to construct an adequate road system in the rural districts at this rate.

Two Methods for Providing Good Roads for Rural Communities

a—Mud hole program, by which all mud holes would gradually be filled to definite line and grade, the drainage having been studied so that they could form a part of a future hard-surface highway system. Mud holes should be eliminated first on those highways carrying school buses and mail carriers. It has been estimated that filling the mud holes alone on all dirt roads in Massachusetts would cost $10,000,000.

b—Progressive or stage type of highway construction by those towns beyond the mud hole stage; that is, the gradual improvement of the highway as is demanded by the increase in traffic. Part of our existing dirt roads that have had some treatment of gravel, could be scarified, regraded, gravel added where necessary, and given a bituminous treatment.

In either case, proper engineering study should be made of materials, etc., so that as much mileage as possible can be built for the money appropriated.

Two experimental pieces of farm road constructed in Worcester county, by the town of Sterling, under the supervision of the Department of Public Works, at less than $10,000 per mile, have proven of great interest to the people of Sterling. The county engineering department furnished surveys, plans, stakes, highway layouts and bounds. The surface consists of either a State standard 8-inch compacted stone fill 10 feet wide, or a gravel fill at least 12 inches deep where the use of gravel proved satisfactory, and 4-foot wide gravel shoulders 6 inches deep, the whole being covered with a layer of gravel for the total width of 18 feet and given a bituminous treatment, so that an all-weather surface was produced. This type of highway can be built for $10,000 per mile or less, depending upon the condition of the existing road and upon the type of country in which road is built.

The title of the Massachusetts law providing for the taxation of sales of gasoline and certain other motor vehicle fuel is *"An act changing the method of raising funds toward the cost of construction and maintenance of highways and bridges by providing that the excise tax on the privilege of registering motor vehicles as fit for operation on the highways in-so-far as it relates to such operation by means of gasoline or other petroleum products be measured in part on the amount thereof consumed instead of wholly upon the horse power or weight and carrying capacity."* The title clearly indicates the original purpose of the tax. It was enacted as a method of raising funds toward the cost of construction and maintenance of highways and bridges. It was not the intention of the 1928 State Legislature that this money be used for other purposes. The 1932 Legislature diverted about $10,000,000 from the highway fund. If it continues to divert this money, the gas tax should be eliminated.

Planning for Secondary Roads

A definite system of farm-to-market roads should be laid out, so that a certain planned number of highways can be improved each year, until the system has been completed.

Not only should the back roads be reconstructed, but all existing improved highways should be carefully maintained from funds set aside from the highway fund for maintenance. The tax payers of Massachusetts are inviting serious losses in their road investments if they fail to do this. Neglect of proper maintenance for only a few months can put unpaved roads into a condition which would involve expensive repairs for reconstruction, much more costly than maintenance, to say nothing of the inconvenience and inevitably higher cost of travelling poor roads.

Increased expenditure on secondary highway construction and maintenance was recommended by the County Highway Officials Division of the American Road Builders Association. The benefits derived from such a program are:

Will keep the unemployed at work on constructive highway projects, as 85 to 90 per cent of the cost of this type of highway is labor.

Will relieve towns to a great extent from using moneys raised by real estate tax for unemployment relief.

More miles of highway can be built today than could be 5 years ago, as costs have fallen almost one-half.

Will bring more people to the farms, and help decentralize population, which is necessary during this depression.

Will increase the value of farm lands and buildings.

Will increase amount of taxable property in rural districts.

Will assist in lowering the county tax.

Will reduce losses to farmers in marketing their products. (To cite a specific case as to loss and inconvenience caused by poor roads: Charles Heslam, a farmer living on Pearl Hill Road, Fitchburg, stated that more than 200 farmers used this one-mile stretch of dirt road, and that the annual loss to farmers by their products becoming Class B products, due to damage by road, would rebuild this mile of road every year. This highway has been reconstructed. Any number of farmers have had to bring milk to main road by horse and wagon, and reload it onto their truck to deliver to their customers in the city.)

About 2½ cents per mile operating cost can be saved on the operation of all types of motor vehicles on paved surfaces as compared to dirt roads.

Will assist in building up abandoned farms.

Will place the farmer in better contact with markets.

Will promote better neighborhood spirit.

Will assist in transportation of school children and mails.

Will enable the country doctor to reach his patients easily.

Will mean more home grown products used by the state as a whole.

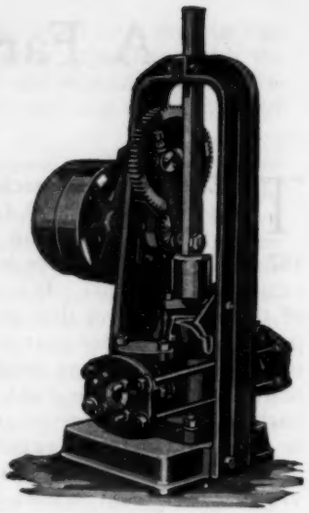
Will create sales in many commodities and stimulate business.

Will increase efficiency of town fire departments.

Mechanical Equipment in Sewage Treatment Works

By A. Prescott Folwell
Editor, PUBLIC WORKS

X—Use of Chemicals

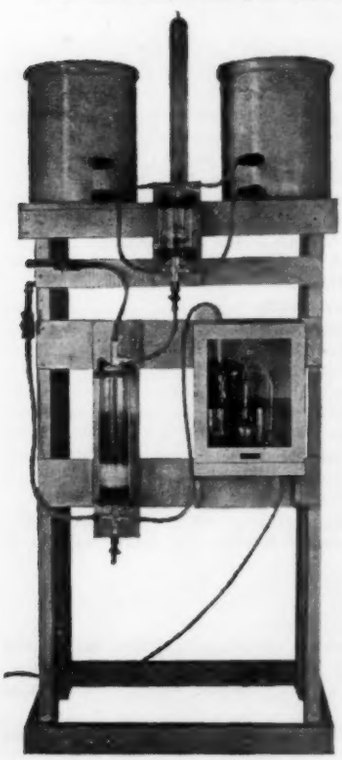


The Duriron Pump

CHEMICAL precipitation of sewage as the sole or chief feature of a treatment plant was common fifty years ago but practically went out of use twenty-five or thirty years ago. However, use of chemicals, chiefly as aids to or supplementing other forms of treatment, has been becoming more or less common during the past decade. The most common use is the correcting of acidity in tank treatment, generally by application of lime. Various chemicals are used for "conditioning" sludge; and chlorination for reduction of oxygen demand, retarding septic action, etc., has been adopted in many plants. Also, during the past three or four years chemical precipitation as a main feature of treatment has again come to the fore.

For precipitation, the chemicals most commonly used are lime, ferric chloride, ferrous sulphate; also paper pulp, marl, cement mill dust and other materials used for their physical rather than chemical effects. For sludge-conditioning, sulphuric acid, alum, chlorinated copperas and ferric salts are in most general use, ferric chloride now being considered to be the best. Zeolite filtering, which is chemical in its operation, is employed in the Guggenheim process.

The above materials, so far as handling is concerned, may be divided into three classes: Soluble solids; insoluble solids; and chlorine gas, generally supplied as a liquid.



Phipps and Bird Feeder

Solids may come in drums, barrels, bags, or (for large plants) in bulk. On reaching the plant (generally by truck) they are handled into the store room by ordinary methods; but if they are to be used on an upper floor of the building, a barrel or bag elevator is desirable. Where materials are handled in bulk, belt conveyors, bucket elevators, etc., should be enclosed to prevent flying dust. A hand crane is an aid in moving heavy containers from truck to plant, and movement from place to place in the plant may be by traveling crane, overhead trolley, etc. A platform scale should be used for checking weight of chemicals received, weighing doses applied, etc. In large plants, automatic hopper or other special scales may be used.

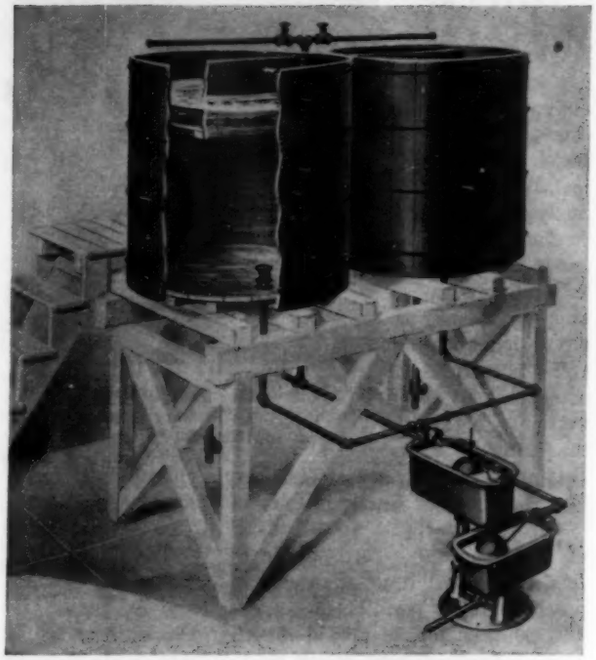
Soluble solids may be applied to the sewage in dry form, and in the case of lime or other materials which are applied in large quantities, are often measured by the bucket full or even shovel. But for anything like scientific treatment, more accurate measuring is desirable. Measuring doses may be done in either the dry or liquid state.

Liquid Feed

In the latter case the solid is mixed with water in vats or tanks. It is well to dissolve the chemical in a dissolving tank, and bring it to the desired strength in a solution tank. The mixing is performed by paddles or by air, or by agitation caused by the entering water. In some cases, where suspension rather than solution is effected, the mixing must be continuous. Mixing by air or water is effected by admitting it through nozzles or grids in the bottom of the tank, or by admitting water tangentially. Paddles are commonly mounted on a vertical shaft, operated by motor mounted on top of the tank or other power, or by hand in small plants. Such equipment is furnished by the Roberts Filter Co., International Filter Co., and other dealers in filter equipment.

Some of the chemicals are very corrosive, and no materials which are attacked by them should be used at any point where solutions of them come in contact with such materials. Ferric chloride is one of the most corrosive, and rubber, duriron or other non-corrosive alloys must be used for equipment handling it. Pumps for handling ferric chloride are made by the Duriron Co. (plunger pump), Quimby Pump Co. (rotary pump), Proportioneers Co. (diaphragm pump) and others.

Hydrated lime costs nearly twice as much as quick lime and in some large plants the latter is used and slaked before use; but this requires special treatment and complicates the measuring of doses. A combined slaker and feeder is furnished by the International Filter Co., in which the quick lime is measured into a slaking tank by a spool-type dry feeder and water is fed into the tank through a meter, so that a milk of lime mixture of uniform known strength is obtained; agita-



International gravity liquid feed plant. Solution tanks above; orifice tank below.

tors in the tank promoting rapid slaking and uniformity of mixture. These can be obtained of capacities ranging from 35 to 2000 pounds of lime per hour.

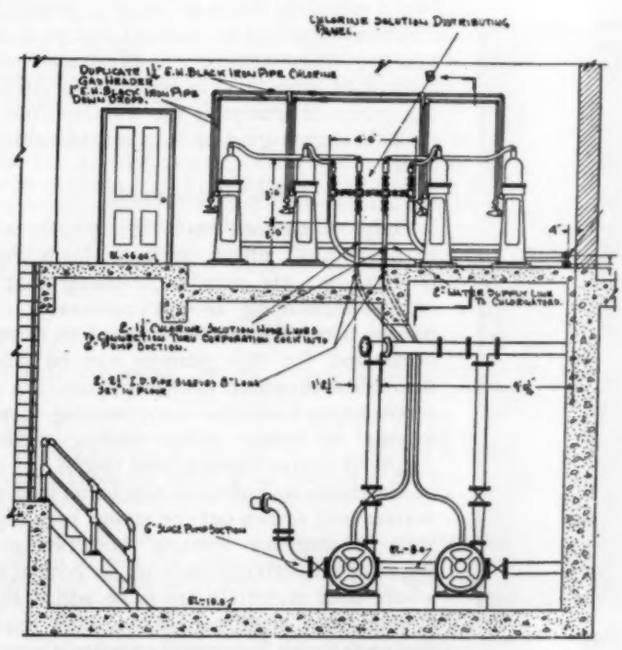
Rates of feeding solutions may be regulated by passing them through an orifice or over a weir under a predetermined head which can be varied as desired, either manually or automatically by the rate of flow of the sewage; or in some cases the size of orifice can be changed. Solution feeds of this kind are furnished by manufacturers of filtration plant equipment. In the experimental plant of the Chicago Sanitary District automatic regulation of ferric chloride dosing is obtained by applying it through a rubber diaphragm pump, the speed of which is controlled by that of the pump which handles the sludge which is being dosed. The Duriron pump has an adjustable stroke by which the discharge is controlled. Another recent solution feeder for small doses of corrosive liquids is the Phipps & Bird, which uses a glass siphon with variable hydrostatic head. For larger quantities the International Filter Co. make a mixer and feeder in which arms, each carrying a cup on its end, revolve in a vertical plane in a round-bottomed tank, keeping the liquid thoroughly mixed, while each cup at each revolution drops into the discharge pipe an amount of the solution which can be varied at will.

Orifices, weirs, valves, pipes and other parts of dosing equipment must be watched to see that no deposits of sediment or crystallization of the solution collect on them, reducing the area of the orifice or weir, preventing seating of valves, or clogging pipes.

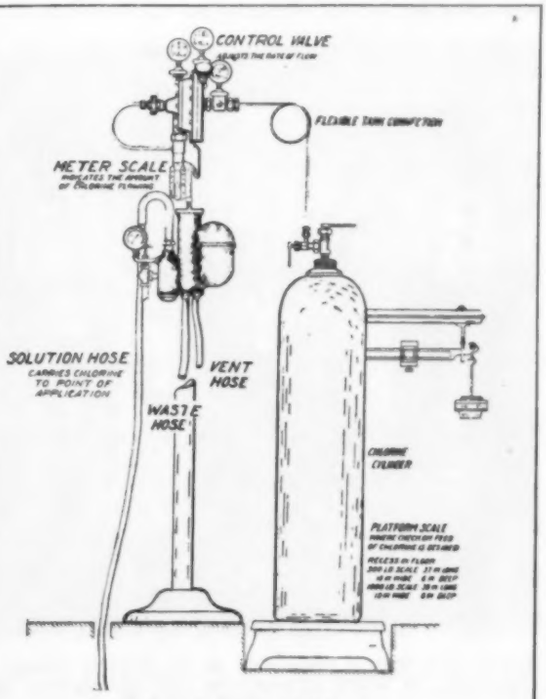
Chlorine Control Units

As liquid chlorine is applied in small doses, and escapes as gas under reduced pressures, and is very corrosive, special equipment is necessary for regulating the rate. (It may be desired to use it at rates as low as 1 or 2 pounds a day.) The equipment must therefore be comparable to laboratory apparatus.

The chloride gas comes compressed into a liquid in containers, and the pressure varies with temperature and the amount that has been used from the container. The gas is very corrosive and it is important that none of it escape into the atmosphere. To make more certain of the last, the measuring apparatus is generally kept under a slight vacuum. It contains a pressure regulator for maintaining a constant pressure, or some other



Layout of chlorine control equipment (W&T) at New Haven, Conn., sewage treatment plant.



Pardee solution feed chlorinator

contrivance for securing uniform rate of flow under varying pressure.

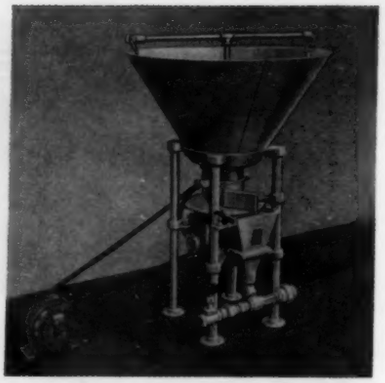
Wallace & Tiernan offer equipment in sizes to feed at rates varying from 1 pound to 300 pounds a day, controlled as to rate either manually or by the sewage flow. The latter is desirable where there are extreme fluctuations of flow and the amount of chlorine used makes close adjustment economical. Most of the equipment is of the vacuum type. A semi-vacuum chlorinator is offered for accurately controlling small amounts. Both vacuum and non-vacuum types of chlorinators are furnished by the Pardee Engineering Co. for solution feed, hand controlled, and also for "dry" gas feed. Each of the several sizes has a range of five times the minimum—0.4 to 2 pounds a day, up to 60 to 300 pounds.

A chlorinator can be used in producing chlorinated copperas, copperas being fed to a solution vat, the solution led from this to the sewage through corrosion-resistant pipe, and chlorine water applied to this pipe just beyond the vat.

Chlorine may be applied by the Marsh electro-chlorination system, in which brine and electric current passed through an electrolytic cell produce sodium hypochlorite, the amount being controlled by the electric current, which can be regulated. The hypochlorite is fed directly to the sewage.

Dry Feed

The chemicals are often measured dry by a dry-feed machine. The chemicals fed may be either powdered or in coarse granular form. There are a number of makes using different principles, most of them employing a hopper with an appliance at its outlet to automatically regulate the rate of flow and a motor to operate same. One of the chief difficulties is to keep the chemical from "arching" or clogging the hopper spout, which is effected by continuous revolution in the hopper of paddles, scrapers, chains suspended from horizontal arms, etc. Regulation of the discharge is effected by varying the height of the hopper spout above a revolving table from which the chemical is continuously pushed, or changing the speed of revolution of the table; by pushing the chemical from a stationary table by a vertical blade, the length or rate of frequency of stroke being changed to regulate the feed, or feeding it by means of a screw conveyor with variable speed. One of the several sizes of revolving table feeds made by Wallace & Tiernan feeds hydrated lime at rates varying from 0.5 pound per hour to 48 pounds, the largest from 7.5 pounds to 480 pounds. These are about 40″ diameter and 50″ high. Another type made by this firm feeds lime at from 0.1 pound to 36 pounds per hour, using a pusher of variable length of stroke; arching being prevented by continuous flexing of the hopper sides and movement of an agitator in the throat. This occupies a space 36″ x 24″ by 64″ high, and is operated by a 1/6 hp. motor which may be run from an ordinary light circuit.



W&T dry chemical feeder. Slide on revolving table below hopper pushes chemical into small hopper at right.

Different materials and different grades of the same material are fed at different rates by the same machine with unchanged adjustment, and when first putting any feeder into service with a given material the rates should be checked at several different adjustments.

The dry chemical so measured may be fed directly into the sewage or sludge, but generally is first made into a solution. When either dry chemical or solution is applied to a tank of sludge or sewage it is often desirable to effect a thorough mixing in some way, as by using a circulating pump or pumping the solution into the tank through a grid or with considerable velocity.

Sewage chlorinating installation at the Easterly Sewage Disposal Plant, Cleveland. 18 W&T vacuum type MSV chlorinators, capacity 6½ tons of chlorine daily.

Non-Soluble Solids

Other solids used for their physical, rather than chemical effect, such as loam, newspapers, etc., are usually so cheap that accurate measuring is not necessary. The papers may need to be reduced to a pulpy mass, and for this purpose can be passed through a shredder, of which there are different types available, some beating them to a pulp in water, others tearing them by means of coarse-toothed steel combs. It may be desirable to pulverize the loam in a pulverizer and screen out the stones before putting it into the sewage. Macerating the paper or pulverizing the loam, or both at once where both materials are to be added to the sewage, may be effected by running the materials through a pug mill or a drum concrete mixer.

Practical Details of Concrete Construction

By William E. Barker

Highway Engineer, Portland Cement Association

IX—Finishing Concrete

FINISHING is the process by which concrete is given a desired surface. This is usually done while the concrete is still plastic, though it may be accomplished after the concrete has partly or wholly hardened.

Finishing Structures

One of the simplest ways of getting a surface finish in structures is to use forms which give that finish. For example, a smooth, unbroken surface is secured by lining ordinary forms with ply-wood or Masonite.

A beautiful wall or panel finish may be secured with tongued and grooved form lumber set horizontally. This is carefully assembled so that the ends of strips butt squarely. To accentuate shadow lines and form a break in an otherwise flat wall the ends of form boards are sometimes wedged out slightly.

Sometimes form lumber having a prominent grain is used. When the forms are removed knots, nailheads and the grain of the wood are plainly visible in the concrete. Such a surface is usually left as it is, or it may be stained.

Surfaces from which the mortar has been removed, to expose the coarse aggregate are also popular for structures and are sometimes used on pavements and walks. The aggregate may be exposed by coating the forms with a proprietary material called "Contex" that prevents hardening of the surface mortar, so that it can be washed away after the forms are removed.

Or the surface may be washed with hydrochloric acid, as soon as the forms are removed, to take off the film of mortar covering the aggregate. One volume of commercial hydrochloric acid to 4 or 5 volumes of water is the concentration recommended, though undiluted commercial hydrochloric is sometimes used by experienced workmen. The acid is applied with a brush and the surface is well scrubbed. As soon as the desired results are secured the concrete must be thoroughly washed with water to remove all traces of acid, else it may work to greater depths than was intended.

If aggregate is to show on the surface there must be some aggregate there, and it should have an attractive appearance. The maximum amount of coarse aggregate that can be used is therefore put in the mixture and both color and size are selected to give the desired effect. Granite or marble chips are commonly used for this purpose, either with or without sand.

The surface secured with ordinary form lumber is frequently dressed in some manner after forms are removed. This may be done by rubbing with a carborundum brick or by grinding with a rotary grinder—a process similar to sandpapering wood. This works best just after the forms are taken off, when the concrete is still damp and not too hard. The concrete is kept damp by sprinkling. If a carborundum brick is used it is frequently dipped in water to keep it clean. Rubbing and grinding must be done with judgment, for if it is too deep, aggregate particles will be disturbed and the surface will be roughened.

An attractive surface can be secured by sprinking a thin paint coat of neat cement and water on the concrete and immediately rubbing it with the carborundum or a rotary grinder. If a lighter color is desired a light gray or white cement is used in the paint coat. Such treatment is excellent for culvert headwalls where good visibility is needed. Excess paint must be brushed from the surface after rubbing is completed.

For best results the grout is applied after the concrete is dry enough to suck the grout into the pores. The surface is first sprinkled lightly to "prime" the suction, then the grout is put on and rubbed in.

Where deeper alteration of the surface is desired, bush-hammering or grinding are resorted to. Bush-hammering leaves the surface roughened while grinding smooths it, and one is frequently used to complement the other. Such finishing

An otherwise plain concrete wall made beautiful by lining the forms with Masonite to secure smoothness; and by breaking the wall up into panels by beading nailed to the forms.

can only be done after the concrete has hardened, else aggregate particles will be loosened.

The grinding is done by carborundum or rapidly rotating steel knives which can be selected to give the desired surface.

Wash coats are not recommended. They have been used to cover a multitude of sins, but unfortunately cover them only temporarily.

Plaster on concrete has not always been successful, but if cement plaster or stucco is used and a certain definite procedure is followed some very attractive finishes can be secured which will be as permanent as the concrete itself.

Surface coatings may also be successfully applied with a cement gun.

Finishing Pavements

Concrete pavements are "finished" to give them good riding qualities, assure drainage and secure a surface to which tires will cling. Such a surface should be as free from inequalities as it can be made, and should, at the same time, have a gritty texture that assures tire grip. The even surface is secured by discarding forms having inequalities that can be detected with a 10-foot straight edge, requiring rigid joint connections, a firm foundation under the full length of the form, and careful form setting. The strike-off template must be heavy enough to remove any concrete that is too high and must have an excess of concrete in front of it, for its entire length, whenever it is striking off. Inequalities are further eliminated by a heavy float 12 to 16 feet long, that is dragged

A driveway in which the gravel coarse aggregate was exposed by washing out the mortar with water before the mortar had hardened.

Above—Sidewalk surface on steep grade roughened by lifting hand float straight up from the concrete. Below—Exposed aggregate surface secured by washing with undiluted commercial hydrochloric acid.

from edge to edge of the slab with its long axis parallel to the center line, or by scraping with a straight edge.

The gritty texture is secured by dragging over the slab a belt of wood, rubber, canvas or burlap, as a final finishing operation.

Sometimes the surface is broken into tiny ridges and hollows by dragging a broom over it. Brooming is especially recommended for airport runways, because it diffuses the glare of the powerful flood lights and makes it easier for aviators to land.

Sidewalks may be classed as a special type of pavement. They must have a surface so even that the least wary pedestrian will not stumble, yet so gritty in texture that they afford secure footing during the wettest weather. The former requires careful striking-off with either a straight-edge or a "crowned" template resting on the forms. The gritty texture is secured by using a wooden float. Steel trowelling should be avoided as it produces a surface that is dangerously slippery when wet.

On steep hills a rougher surface is sometimes secured by lightly pressing a hand float onto the fresh concrete, then lifting it up vertically. The suction of the float, as it is lifted, forms little ridges of mortar, like the hills of a miniature relief map, and these prevent slipping.

The things to avoid in finishing concrete walks, drives and pavements are steel trowelling, disturbance of a partly hardened surface, excess surface mortar, and spreading mortar over a partly hardened slab.

Coloring of concrete by the addition of pigment to the mortar, painting, staining or metal plating its surface are also types of finishing but will be treated in a separate article.

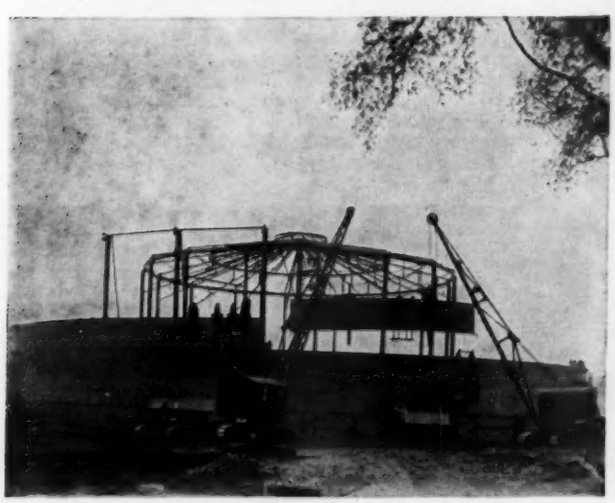
Arc Welding Six-Million-Gallon Water Tank

By B. Ferguson

Chief Engineer, Harnischfeger Corporation

An innovation in the art of electric arc welding was employed in constructing a 6-million-gallon water tank which is part of the Menominee Valley booster station project, undertaken by the city of Milwaukee to provide for peak load conditions in the western and southwestern areas of the city and its suburbs. This tank, said to be the largest ever constructed, does not contain a single rivet in the entire shell.

The A. O. Smith Corporation of Milwaukee, which received the contract for the erection of the tank, began actual work the latter part of September by laying a circular bed of concrete 165 feet in diameter for the foundation. This was covered with a coat of asphalt, on which was laid the bottom of the tank, of ⅜-inch steel plates welded together.



Tank under erection, showing support for roof.

Following this, the bottom ring of the side plates, of 1 3/16-inch steel weighing four tons each, was welded to the floor plates inside and out. The plates of the next ring were then set in place and welded; being slightly thinner than the plates below, an offset on each side gave room for a satisfactory welding head inside and out. Each ring was made slightly thinner than the one below; the top ring of the tank, which is 37½ ft. high being ½ inch thick.

The plates were all placed in position by means of three Harnischfeger crawler cranes, and the welding was done with ten gasoline-powered P. & H. "Hansen" arc welders. In placing the sheets, each was handled by two cranes carrying special jaw grapples clamped down over the entire width of the sheet and extending over several feet to form a support for the sheet while welding.

The roof of the tank consists of welded sheet steel, supported on structural steel work erected inside the tank. Three sheets of roofing were welded together on the ground, and placed in position by means of a crane equipped with an eighty-foot boom. The sheets, after being placed in position, were then welded down to the structural frame work which supported them.

300,000 Miles Without an Accident

For the fourth consecutive time the trucking department of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa., has been awarded a plaque and "no accident" certificates in the Drivers Inter-fleet Safety Contest. These contests, sponsored by the Western Pennsylvania Division of the National Safety Council and the Better Traffic Committee of the City of Pittsburgh, cover six month periods each, in the last of which 110 fleets participated.

The awards show that this fleet has completed four contests during the past two years without a chargeable accident. Having travelled a distance of 300,000 miles in a working time of 70,000 hours, the drivers are justly proud of their safety record.

THE EDITOR'S PAGE

Specifications and Patents

Combining, as it must, exact and comprehensive knowledge of both the engineering and the legal principles involved, the writing of specifications that will insure obtaining the desired results from a contract is perhaps the most difficult problem put up to the designing engineer. And among the most difficult features of the specifications for many classes of work are those providing for selection of manufactured articles and of patented equipment and processes.

As to choice of manufactured articles and materials, whether or not patented or proprietary, the chief difficulty lies not in deciding what the engineer wants but in writing specifications which will obtain them and still will meet the legal requirements of state or city aimed at securing competition. Requiring the use of the *A* hydrant, the *B* sludge collector, the *C* traffic signal, "or others equally as satisfactory," "or their equivalents," etc., is not entirely satisfactory, for this still leaves open for dispute (or even lawsuit) the determination of what "equally satisfactory" and "equivalent" can be construed to mean.

Wm. E. Stanley, in a paper before the Wisconsin Section of the American Water Works Ass'n, says: "A more desirable method is to require and to specify, with considerable exactness, the functions to be performed by each device, including limiting degrees of accuracy, and also require that all such equipment be subject to approval before installation and subject to test after erection." In selecting the requirements, the engineer must be careful to avoid undue influence by representatives of manufacturers, who are often very skillful in securing the insertion in specifications of clauses which will exclude all materials except their own. We have seen such clauses the inspiration of which was as apparent as would be specifications for cigarettes which should not have a cough in a carload.

More difficult, or perhaps "precarious" better defines it, in some lines of public works is dodging the possibility of entanglement with the patent laws. Scores of cities in years past have been surprised by service in suits for infringement of patents for pavements, septic tanks, equipment details of filter plants, etc. A decision just handed down on a patent claimed for the activated sludge process (probably to be appealed) may be a forerunner of similar claims for royalty to be made against all users of that process; and suits are threatened against users of common methods of sludge digestion tank operation. Few engineers were aware of the possibility of such suits until they were filed; and were incredulous of the possibility of their success until the courts handed down their decisions.

This is a general problem which should be obviously considered by engineers and public works officials. One method commonly employed is to require the contractor doing the work or the manufacturer furnishing equipment to furnish bond to protect the city against all suits for infringement. But this can hardly cover a process forming the basis of the engineer's design and on which a patent is claimed later on. Shall the engineer furnish bond to protect the city against process patents?

There would seem to be an opening for a patent bond and guarantee company which will, for a fee, pass on any set of plans and specifications and agree to protect against infringement suits or designate what processes or equipment included in the plans they refuse to guarantee.

Public Works Construction Volume and Outlook

Disregarding the boom period of 1928-29, the annual volume of construction work in this country, previous to 1932, has averaged around 8,000 million dollars, of which about one-third was due to public improvements. In 1932, the volume of construction work shrunk to about 3,000 million dollars, of which roughly 1,500 million dollars represented expenditures for public works construction.

Where private construction has shrunk to 25% of its former volume, public construction remains above 50%. Or, putting it another way, public work, which in previous years represented only 37% of total construction expenditures, now represents half of the total.

There are sufficient projects in the public works field, now urgently "needed and in the public interest," to bring the total volume of public construction nearly to the pre-depression figures. Carrying out these projects would contribute greatly to the relief of unemployment and many of them would be self-liquidating and would not increase taxes by a single penny.

A survey now being made by PUBLIC WORKS has drawn replies from something over five hundred cities and another five hundred replies are expected. Over eight per cent of these cities are planning new sewage treatment plants; even more are ready to go ahead with plans for improving water facilities; and fully half the cities contemplate doing more or less paving and other street improvement work. The work is planned in spite of the unreasoning (in many cases) demand for tax reduction. We believe that attitude will change when the public realizes that money must be spent either for public relief or for permanent and useful public works. When that time comes, the man who has read and acted on Mr. Brockway's advice on another page of this issue will be able promptly to take advantage of his opportunity.

A Series of Articles by National Leaders

The first of a series of articles by nationally known leaders in political, administrative and construction fields will appear in an early issue of PUBLIC WORKS. The authors of these articles will include, among others, Governor Pinchot of Pennsylvania, Surgeon-General Hugh S. Cummings of the United States Public Health Service, and M. William Bray, Lieutenant Governor of New York. These men will give their views on the problems of the day and the methods of solving them, thus bringing to our readers a broader view of national affairs, as they affect the public improvement field.

Bacterial Efficiency of Water Purification

Summary of Results and Conclusions Derived From Studies by the U. S. Public Health Service

By H. W. Streeter

Sanitary Enginer, U. S. Public Health Service, Cincinnati, Ohio

During the years 1915-16 and 1923-29, the U. S. Public Health Service, in connection with investigations of stream pollution, made a comprehensive field and experimental study of the efficiency and limitations of current processes of municipal water purification. The primary object of the study was to determine whether and to what extent, if any, it might be desirable or necessary to restrict the degree of pollution of navigable surface waters used as source of purified municipal water supplies. The detailed results of these studies having been published in various reports, the present paper is intended as a covering report, to summarize the results and conclusions of the combined investigation. (See PUBLIC WORKS for November 1926 and December 1927).

The results of the work are based on: (1) a preliminary observational study of the routine performance of the Cincinnati and Louisville filtration plants in 1915-16; (2) a collective survey of 31 municipal water purification systems located along the Ohio and certain other rivers and also the Great Lakes, and (3) the operation of a large-scale experimental water filtration plant for a period of five years at the stream pollution laboratory of the service at Cincinnati. In the experimental work, attention was given: (a) to observations of normal efficiency under conditions of operation similar to those existing at the municipal filtration plants along the Ohio river, but with a wide range in raw water pollution, and (b) to a study of the increased efficiency obtainable from certain modifications in pre-filtration treatment of Ohio river water.

Relations Between Quality of Influent and Effluent Waters

THE results of the preliminary study at Cincinnati and Louisville in 1915-16 gave definite evidence of a well-marked relation existing between variations in the quality of the raw water and concurrent variations in the quality of effluent obtained at each successive stage of treatment. These results were confirmed by the later and more extensive field surveys and experimental work to such an extent as to indicate that a basic law, similar in its effect to that of physical adsorption, appears to govern the performance of all processes of water purification. This law has been confirmed later by the studies of Malischowski in Europe, who states that it is applicable to both water and sewage treatment. It may be expressed in simple mathematical terms thus:

$$\log E = n \log R + \log c$$

or

$$E = cR^n$$

in which (R) denotes the average bacterial content of the raw or influent water, (E) the corresponding content of the effluent water and (c) and (n) empirical constants defining the efficiency of bacterial removal and the range of variation in the quality of effluent.

Observations in Bacterial Efficiency

Operation of the experimental plant during the first 15 months established the similarity between its efficiency and that of the average large-scale Ohio river municipal filtration plant under comparable raw water conditions. This observation was one of practical importance in considering the applicability of the experimental results to large-scale plant operations.

With chlorination excluded, the average Ohio river filtration plant was found to be more efficient than the average Great Lakes plant, though this advantage was comparatively small when chlorination was included. A further comparison of the data obtained from these two groups of plants indicated that the lower efficiency of the Great Lakes group without chlorination was not due primarily to the greater clarity of Great Lakes water, but apparently to some difference in its chemical content, reflected in a distinctly higher pH value (ranging from 7.8 to 8.2, as compared with 6.8 to 7.2 in Ohio river water). The experimental data showed that the bacterial efficiency became sharply diminished at pH values exceeding 7.0.

Comparison of the average efficiency of the several individual filtration plants revealed rather wide variability, explained in part by differences in the average density of raw water pollution and in part by known divergences in plant design and operation, notably in the total periods of sedimentation provided in the dosages of coagulant used and in the amounts of residual chlorine carried in the final effluent. In a few instances no reason could be assigned for these efficiency variances, though they doubtless could be accounted for by certain minor diversities in design and condition of operation, to which water purification plants are often extremely sensitive.

Variations in Quality of Raw Waters and Effluents

From an analysis of the data obtained from the 31 plants surveyed, covering in each case a period of a year, it was found that the variations in bacterial content of both raw waters and effluents tend to follow the law of logarithmic frequency distribution. Thus, when the logarithms of the bacterial numbers observed on individual days were arranged in the order of a frequency distribution, the resulting curves approached closely that of the symmetrical "normal frequency" type. A definite relation was shown to exist between the average bacterial numbers observed in the several raw waters and effluents and the frequency with which these numbers exceeded various amounts, including the average itself. The frequency with which the B.coli index exceeded its yearly average was 25-30 per cent in both Ohio river and Great Lakes raw waters. It approximated 50 per cent in the final effluents.

Effects of Modifications in Preliminary Treatment

From a series of experimental observations on Ohio river water, occupying about two years, it was found that the bacterial efficiency of prefiltration treatment was increased materially by prolonged sedimentation up to about 12 hours and by the use of added amounts of coagulant, but was sharply diminished at pH values exceeding 7.0 or thereabouts, tending to increase as the pH ranged downward from 7.0 to about 5.5. Double-stage coagulation-sedimentation was indicated as having little advantage, if any, over single-stage treatment of the same kind when the total periods of sedimentation and amounts of coagulant added to the water were alike.

Further experiments, dealing with the bacterial effi-

ciency of raw water prechlorination and excess-lime treatment, occupied an additional 21 months. The results of these experiments indicated a decided advantage in prechlorination, when used in conjunction with postchlorination, but a slight disadvantage as compared with the latter when each method was followed alone. Prechlorination was found to lower the bacterial efficiency of rapid sand filters, to a degree roughly proportionate to the residual chlorine content of the water applied to the filters. It also yielded a slightly lowered efficiency of postchlorination, when both methods were used together. With these limitations, the net gain in efficiency resulting from the addition of prechlorination to ordinary rapid sand filtration treatment was very substantial and consistently maintained.

Observations of the bacterial efficiency of excess-lime treatment, occasionally used as an alternative to chlorination to avoid taste and odor difficulties, showed a decided gain in efficiency when the residual causticity of the lime-treated water was 15-20 p.p.m. or more (corresponding to a pH value of 10 or above in the water treated). With only monocarbonate alkalinity present, the bacterial efficiency after 6 hours' retention of the treated water was not measurably increased, though Bahlman has reported better results with longer contact periods.

Application of Data

The relationships observed between the bacterial quality of raw, or influent, water and the corresponding quality of effluent were so well-marked at all of the municipal plants surveyed, as well as from the experimental studies, that it was possible to formulate curves showing the quality of effluent produced from raw water of any extent of pollution, within the range of the data, by an average plant or process of given degree of elaboration, ranging from simple chlorination to complete rapid sand filtration, with chlorination and prolonged double-stage sedimentation. From such curves it also has been possible, conversely, to estimate the maximum limit of raw water pollution corresponding to an effluent of specified quality.

From the most reliable data obtained from the studies, the following maximum numbers of raw water B.coli corresponding to a quality of effluent falling within the limit of the present U. S. Treasury Department standard (i. e. B.coli index not exceeding 1.0 per 100 c.c.) have been derived, for various degrees of treatment:

	Limiting Raw Water B.coli Index per 100 c.c. (Round Numbers)	
	Ohio River	*Great Lakes*
(1) Chlorination alone	80	50
(2) Coagulation, sedimentation and rapid sand filtration (without chlorination)	80	60
(3) Same as (2) with prechlorination	3,500	—*
(4) Same as (2) with postchlorination	6,000	4,500
(5) Same as (2) with both prechlorination and postchlorination	20,000	—*
(6) Same as (4) with double-stage sedimentation (relatively long sedimentation period)	50,000	—*

*No observations.

For the average plant of ordinary type, with postchlorination included, a rounded mean limit of 5,000 per 100 c.c. could be applied to the purification of either Ohio river or Great Lakes water without serious error. With both pre- and postchlorination, the allowable limit would appear to be about 20,000 per 100 c.c. (a fourfold increase). Without the aid of chlorination, it is

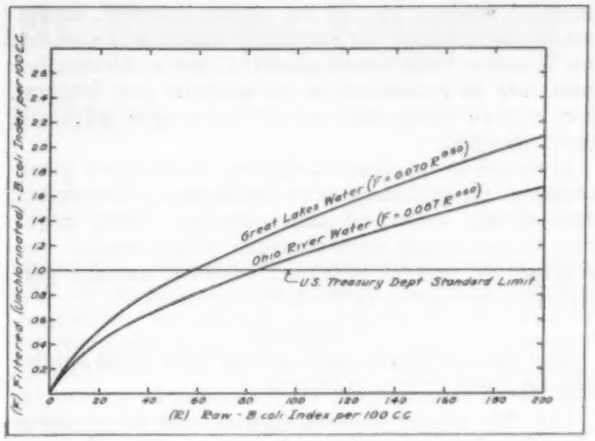

(F) Filtered (Unchlorinated) - B coli Index per 100 CC
Great Lakes Water (F = 0.070 R^0.80)
Ohio River Water (F = 0.067 R^0.80)
U.S. Treasury Dept Standard Limit
(R) Raw - B coli Index per 100 CC

Fig. 1—Relation observed between B. coli index of raw water and corresponding index of unchlorinated filtered effluent. (Based on average data from purification of Ohio River and Great Lakes waters, respectively)

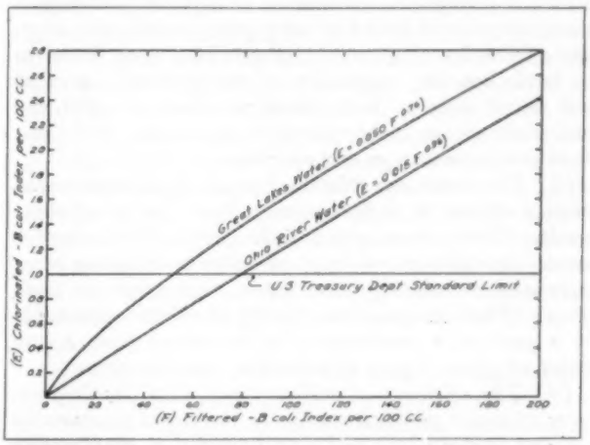

(E) Chlorinated - B coli Index per 100 CC
Great Lakes Water (E = 0.050 F^0.70)
Ohio River Water (E = 0.015 F^0.95)
U.S. Treasury Dept Standard Limit
(F) Filtered - B coli Index per 100 CC

Fig. 2—Relation observed between B. coli index of unchlorinated filtered effluent and corresponding index of chlorinated effluent. (Based on average data from purification of Ohio River and Great Lakes waters, respectively)

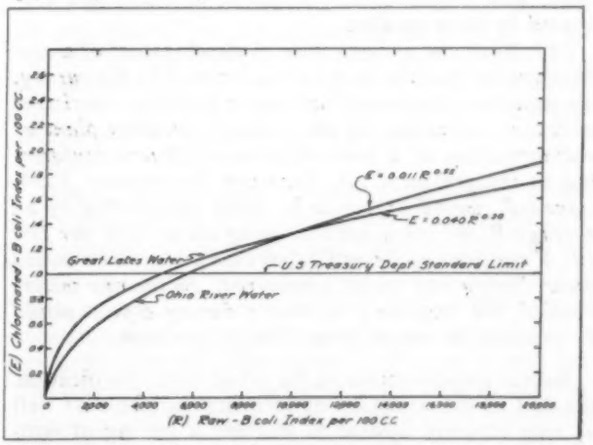

(E) Chlorinated - B coli Index per 100 CC
E = 0.011 R^0.92
E = 0.040 R^0.70
Great Lakes Water
U.S. Treasury Dept Standard Limit
Ohio River Water
(R) Raw - B coli Index per 100 CC

Fig. 3—Relation observed between B. coli index of raw water and corresponding index of chlorinated filtered effluent. (Based on average data from purification of Ohio River and Great Lakes waters, respectively)

doubtful whether any of the plants observed, except one or two, could produce effluents consistently meeting the Treasury Department standard; hence chlorination must now be considered as an essential and integral part of their equipment, rather than a mere operating factor of safety.

It should be emphasized that the limits above given represent the performance of the *average* plant, rather than of any individual plant surveyed, which might vary to some extent from the mean in this respect. For purposes of general appraisal, however, average performance appears to be the better criterion.

Conclusions

The general conclusions reached from these studies may be stated briefly as follows:

(1) The results obtained appear to be fairly representative of those which may be expected from the average plant or process of the types observed, when treating waters of the Ohio and other similar rivers and also those of the Great Lakes.

(2) Although the efficiencies of different individual plants have been found to vary quite widely, the average efficiencies of groups of plants have been found to be fairly similar, regardless of the general source of raw water supply. Individual variations in efficiency have been shown to be related, in most cases, to known divergences in design and operation.

(3) The consistent relationships observed between the quality of raw or influent waters and that of effluents produced from them appear to be governed by a fundamental law, characteristic of all water purification processes and simulating adsorption phenomena in their effects. This law limits the quality of effluent obtainable by a particular combination of treatment from a raw water of given degree of pollution, and vice versa.

(4) The efficiency of ordinary and more simple processes of water purification can be increased measurably through elaborations and modifications of prefiltration treatment, notably by prechlorination, by longer periods of sedimentation, by improved coagulation resulting from pH control and more liberal use of coagulants, and probably also by other measures not embraced by these studies.

(5) With the present state of development of water purification practice in the areas covered by the survey, the maximum degree of raw water pollution consistent with the production, by the average filtration plant of ordinary type, of a final chlorinated effluent conforming to the present U. S. Treasury Department B.coli standard, would appear to be fairly represented by an average B.coli index not exceeding about 5000 per 100 c.c. Variations above and below such a maximum would occur during any period considered. In the raw waters studied, the frequency in excess during a year would be expected to range from 25 to 30 per cent.

Recent improvements in the art of water purification, notably in the direction of securing palatable as well as safe effluents, appear to warrant a feeling of optimism as to the ability of filtration systems of the types now in general use to deal successfully with the present encroachments of pollution in their sources of raw water supply. When some of these improvements become permanently incorporated, as they doubtless will be, into general water purification practice, a substantial upward revision of the average limits of raw water pollution indicated by the results of those studies probably will be justified. There is some danger, however, lest the present feeling of optimism may go too far in this respect, even to the extent of disregarding excessive bacterial pollution as being a negligible factor in future problems of water purification. That such an assumption would be extremely hazardous is clearly shown by the results of these studies, which have failed to record a single instance in which a water purification system gave any conclusive evidence of being able to produce an effluent safe and palatable from raw water of unlimited degree of pollution. The evidence, in fact, has been consistently to the contrary.

In certain industrial areas of the country, allowable limits of raw water pollution may prove ultimately to be conditioned more largely by requirements of palatability, reasonable softness and general wholesomeness of purified waters for domestic use than by those of sanitary quality. In this connection, however, cannot be disregarded the possible relation of water-borne outbreaks of gastro-intestinal disturbances, such as were recorded along the Ohio river in 1930, to the presence of chemically or biologically toxic substances in purified water supplies derived from sources highly polluted both by sewage and by certain kinds of industrial wastes. Although urban typhoid fever has been greatly reduced, it is an ever-present hazard, as the recent survey by Wolman and Gorman has shown.

Further reinforcement of water purification systems dealing with highly polluted raw waters probably will tend to follow present lines, notably in the direction of intensified chlorination, aided by ammonia and activated carbon treatment, and in that of elaborated and improved preliminary treatment of water. Storage, both natural and artificial, will assume a role of increased importance as its advantages become more widely recognized. Treatment of sewage and industrial wastes will receive more attention as special measures for protecting water supplies. Further studies of the relative values and economy of these several measures are needed, preferably along the general lines of combined observation and experiment such as have been followed in these studies.

Abstract of paper presented to the Kentucky-Tennessee section of the American Water Works Association.

Extreme Cold and Snow Plow and Truck Design

Commenting on the developments in truck design during the past year, W. A. Olen, president of the Four-Wheel-Drive Auto Co. stated that considerable work had been done by the engineering department of that company toward further perfecting FWD trucks for snow removal. He stated that when trucks are operating in bucking snow at temperatures more than 20 degrees below zero, the metal is weakened under impact by about 30%, and at 30 degrees below zero, it is weakened by as much as 50%. In addition to this weakening of the metal under these conditions, it was found that lubricants which lubricate the parts and furnish a cushion to take impacts, were in a great many cases inadequate for service under these conditions. The Metallurgical Department in conducting tests of lubricants used throughout the country found that many of them were unfitted for such work. For instance, tests on five samples of lubricants sent in by one state highway department showed that four of these were unsuited for the work.

Sewage Treatment with Ferrous Sulphate and Aeration

By P. B. Streander

ONE of the recent chemical treatments of sewage which have been advocated involves the use of ferric chloride or other ferric salt, which is relatively expensive. Ferrous sulphate is the least expensive of the iron salts, but it was thought that it could not be used successfully with septic sewage or other organic wastes devoid of oxygen, since the ferrous hydroxide formed by ferrous sulphate and lime is soluble to the extent of about 7 parts per million and would be discharged in the effluent and precipitated later.

The writer has endeavored to solve the problem thus presented by aerating the sewage and ferrous sulphate, applying sufficient lime to neutralize the free carbon dioxide and maintain a pH sufficiently high to favor the oxidation of the compound to the ferric state. An experimental plant of 20,000 to 30,000 g.p.d. capacity was constructed at the Northeast Sewage Treatment Plant, Philadelphia, consisting of a so-called floculation tank having a detention period of between 20 and 30 minutes; a precipitation tank providing a settling-out period of between 45 and 60 minutes; and a sand filter operating at a rate of between 1 and 1½ gallons per minute per square foot filter area with a loss of head of about 12 inches. Sewage is lifted from a small well by means of a pump and discharged into a weir box for control and measurement of the sewage. From this box it flows into the floculation tank, which is of the air-lift channel type. In this tank the lime and ferrous sulphate are added, together with returned sludge and such inert materials as clay or cellulose. Air is blown through the diffusors at one side of the tank, setting up a spiral flow motion to the entire mass. The application of the minute air bubbles and the surface absorption of oxygen from the atmosphere provide the oxygen necessary to meet the oxygen demand of the sewage and the oxidation of the ferrous sulphate. Herein is formed a voluminous floc which settles out rapidly.

From the floculation tank the sewage is piped to the precipitation tank, which is of the downward-upward-flow type, in which the chemical floc and sludge are quickly precipitated. A small part of this sludge is returned to and mixed with the incoming raw sewage, the balance is wasted. (In an actual plant this can readily be dewatered by means of a vacuum filter.) In this precipitation tank practically all of the solids are removed, the minute so-called pin-point floc being carried over with the settled sewage to the sand filter. The sand filter is circular in shape and is provided with a mechanical cleaner by means of which the strained-out floc can be removed without shutting down the filter. This filter removes from the sewage the minute floc and light turbid matter and delivers an effluent clear and sparkling in appearance.

This process utilizes the incipient floculation produced by aeration as a mechanical and chemical means of aiding the floculation of ferric hydroxide with the suspensoids and colloids present; utilizes inert materials for the accretion and cellulose for the aggrandizement of the colloids and suspensoids present; and by returning the sludge the small amounts of unreacted chemicals are used for the revivification of the chemical, or/and sulphuric acid for the regeneration of ferric hydroxide to ferrous sulphate.

While long-period continuous runs have not been made, the results so far accomplished are quite promising. The amounts of chemicals added to the sewage have been constantly reduced. From present indications it would appear that a clear, sparkling effluent can readily be obtained by the addition of not more than 600 pounds of lime and 300 pounds of ferrous sulphate per million gallons of sewage. The volume of air added is not more than one-twelfth of a cubic foot per gallon of sewage. Clay or cellulose materials will not exceed 200 pounds per million gallons. The total cost of chemicals and power will not exceed $5.00 per million gallons, with unslaked lime at $9.00, ferrous sulphate at $10.00 and cellulose or clay at $5.00 per ton respectively. No chlorination experiments have yet been conducted, but it can safely be presumed that to obtain a residual of 0.5 p.p.m. not more than 5 p.p.m. of chlorine need be added.

The results which can be obtained with modernized chemical precipitation, based on experiments made so far, closely approach those produced by an activated sludge plant. The results are not as complete in the oxidation of nitrogenous compounds, but if followed by chlorination will in most instances meet the dilution requirements of the receiving water. The appearance of the effluent is clear and sparkling. The bio-chemical oxygen demand can be reduced by as much as 75 per cent, its relative stability will be between 4 and 5 days, it will contain dissolved oxygen up to 6 to 8 p.p.m., colon bacilli will be absent and a practically stable sludge will be produced having a moisture content of between 65 and 70 per cent.

One of the important advantages of such a process is its adaptability to practically any site. A 6-million-gallon plant can be constructed within an area 120 feet square and, if necessary, every part of the plant can be fully housed in. It can without fear of nuisance be constructed immediately adjacent to residential or business districts. The capital cost is relatively low, The operating cost is somewhat predicated on the characteristic of the sewage or the water supply, but chemical costs and power for aeration will not as a rule exceed $5.00 per million gallons. Labor costs need not be high, as most of the work is accomplished by machinery. When cost comparisons are made on an annual basis, including interest, bond retirement and operation, this method of sewage treatment will be considerably less than, say, activated sludge and will even compare favorably with the primary treatment costs.

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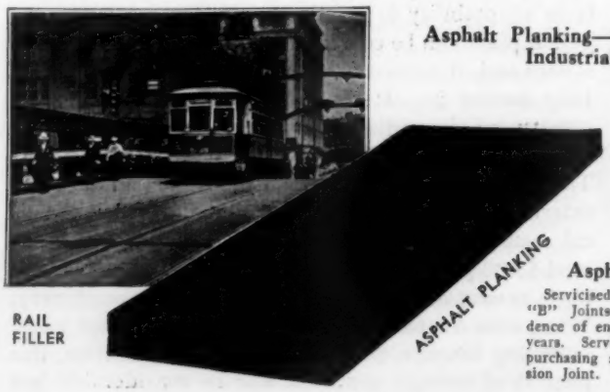

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Fluxed Asphaltic Limestone as Seal Coat for Mixed-in-Place Surfaces

By J. H. Conzelman

THE use of a thin coat of cold-laid fluxed asphaltic limestone on road mix or mixed-in-place construction is a development that gives promise of greatly increasing durability and reducing maintenance on these low-cost bituminous surfaces. Practically, this development consists of placing a small amount of high-type bituminous paving mixture in the surface voids and as a cushion over the coarse aggregate.

In the fluxed asphaltic limestone seal coat work which has been done to date, specifications have called for the use of as low as sixteen and as high as fifty pounds of the mixture per square yard, thirty pounds being most common. After the road mix has been rolled and six to eight pounds of chips swept into the voids, it is allowed to cure and toughen for a period of not less than three days. A seal coat of the same bituminous material used in the road mix is then spread at the rate of 0.1 to 0.2 gallon per square yard, depending on the character of aggregate used in the road mix and its need for additional bitumen. Trucks then distribute the fluxed asphaltic limestone mixture on the surface in small piles of such size as to give the desired spread per square yard. These small piles are windrowed with a rubber-tired self-propelled grader, in the center of the road if the width is great enough to take care of traffic on both sides of the windrow, or if not, on one quarter of the pavement.

The windrows are then evenly distributed over the surface by the rubber-tired self-propelled grader; a clapboard drag six to eight feet wide built of 2x8 planks often being used behind the grader to facilitate spreading the seal coat evenly and break up any lumps present. In spreading the seal coat, best results are secured by wasting the mixture lightly on each trip, that is, by building up the thickness slowly as the mixture is carried by the blade back and forth across the road. One grader can spread from ½ to 1 mile of seal coat per day.

As a rule, the seal coat is not rolled. Traffic is allowed on the surface during its construction, and this traffic, together with the compaction secured from the grader wheels, compresses the seal coat very satisfactorily. Care is taken to compress the edges, and the very small amount of material wasted over the edges of the surface, by running truck wheels along these areas.

An exceptionally true, even-riding surface is secured on these asphaltic limestone seal coat projects. Very often the plan of constructing the job results in the road-mix surface being subjected to traffic for one to two months before the seal coat is applied. Slight irregularities in thickness and compression brought out by traffic during that period are corrected by the seal coat. The surface secured has the dense but rather granular texture peculiar to cold-laid Alabama asphaltic limestone, which makes a non-skid surface.

Top left: This picture was taken the day the seal coat was spread, and shows it being compacted by traffic. Lower left: Spreading the seal coat. Top right: Road finished with 30 pounds per sq. yard of fluxed material. Lower right: Close-up of surface.

Mixed-in-place surfaces of the macadam aggregate type usually contain no aggregate finer than ¼" to ½" particles, and are therefore high-void mixtures which must depend on a seal coat for protection against surface moisture, which, if not kept out, would make ineffective the type of foundation these surfaces are laid on. Penetration of moisture in the surface would also result, in time, in breaking the bond between the aggregate and its bituminous coating, causing raveling and disintegration. This is especially true of mixed-in-place surfaces, for

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they are mixed cold and are often constructed of an aggregate having a considerable coating of finely pulverized or colloidal matter. It has been found in many instances that this colloidal matter, depending on its character, results in emusilfying bituminous coatings in the continued presence of moisture. These high-void bituminous surfaces should be sealed as thoroughly as possible from surface moisture. This can be done successfully as described above, using a finely graded mix ranging in size from ⅜" to dust. This material makes a dense, waterproof covering and definitely keeps surface moisture out of the pavement.

The experience to date with this type of seal coat on road mix or mixed-in-place, together with the service history of thin asphaltic limestone surface treatments in Texas, and the theoretical advantages of this material for such service, indicate that its use will result in considerably lower maintenance cost and greatly increased life for these low-cost bituminous surfaces.

Resurfacing Pavements With Thin Bituminous Layers

By A. O. Hastings

District Engineer, Indiana State Highway Commission

MANY of our older pavements are so worn that light maintenance repairs will not keep them in good condition, but still have such strength that it is not economical to tear them up. By applying a new wearing surface the original investment in the old pavement is conserved; resurfacing materials can now be obtained at very low cost; and the operation can be completed with little or no interruption to traffic.

In planning resurfacing, the engineer should 1.—Study the amount and kind of traffic that is to use the road; 2.—Investigate the strength of the old pavement to be resurfaced; and 3.—Determine the availability and cost of possible resurfacing materials. If the old pavement is sufficiently strong to carry the traffic, a very light resurfacing may be used; but most old pavements are not quite strong enough and on these a thicker resurfacing course should be used. Irregularities should first be patched out with a mixture of crushed aggregate and bituminous material, and the entire surface stabilized to a fairly equal strength.

In Indiana some short stretches have been resurfaced with a very thin course, ¾ in. to 1 in. thick, but generally such resurfacing has not been as successful as that 2 in. or more thick. During the past ten years the state has resurfaced pavements of old cement concrete, of brick laid on compacted gravel or on cement concrete, of bituminous gravel, and old treated stone roads; using several types of bituminous mixtures in such resurfacing.

In 1926 several types of bituminous mixtures were used experimentally on a portion of state road No. 67, which was of reinforced cement concrete. Before resurfacing, all badly broken places were removed and replaced with new concrete. For surfacing, emulsified asphalt, bituminous concrete, amiesite, bituminous macadam, penetration macadam, and rock asphalt were used on different stretches. The first two have not lasted as well as the others; and the last has given some trouble due to base failure.

During the past season, we resurfaced some stretches of old brick and old bituminous macadam. On the brick section and parts of the macadam section, bituminous coated aggregate with a rock asphalt wearing course was used. The old surface was given a treatment of

emulsified bitumen, approximately 0.15 gallons per square yard, and bituminous coated aggregate (pre-cote method) was then spread on the surface to an approximate depth of 2 inches, using stone spreader boxes to gauge the amount used, and was leveled mechanically by use of a planer drawn by a tractor, or by use of a Gledhill attachment on a 12-ft. blade grader. Later the bituminous coated aggregate was thoroughly rolled, and a rock asphalt wearing course, approximately 70 pounds per square yard, was placed thereon. This rock asphalt was shoveled onto the road between metal strips which gauged the exact depth of the course. The surface was thoroughly luted and smoothed, rolled once over with a 5-ton roller, leveled with a long-base planer, then rolled and opened to traffic. This resurfacing not only smoothed up an old surface that had become very rough and objectionable to traffic, but it also added considerable strength and, in my opinion, presents a surface that will show very little maintenance cost for some time to come.

Some of the old bituminous macadam stretches were resurfaced using our specifications AHMC (hot mix laid cold) spread to an approximate depth of 2 to 2½ inches, with a ¾-inch rock asphalt wearing course. Size No. 34 stone was used for coarse aggregate and asphalt as a bituminous material. This mixture was placed without a prime coat. It was delivered onto the surface from end-dump trucks, chaining the end gate to gauge the amount put on. This course was then leveled with a 12-foot blade grader with a Gledhill attachment. A very smooth and uniform surface was produced which was thoroughly rolled and a rock asphalt wearing course placed by the methods previously described. This method of resurfacing was very satisfactory, as it leveled up the old base, added considerable strength to the old surface, and presented a smooth, non-skid surface for traffic. The cost of maintenance on this stretch of road should be very small for some time to come.

We resurfaced another stretch of bituminous macadam where it was necessary to reduce the crown and level up an old base that was adequate in strength, but was very rough. We used AHMC in this also, but No. 36 aggregate in the binder course. This binder course was spread thick on the edges and thinner toward the center of the roadway, reducing the crown and patching out the depressions, varying from 3½ inches to 1 inch in thickness. No. 6 aggregate was used in the mixture for a top course, which was spread with a 12-foot blade grader with a Gledhill attachment and varied in thickness from practically nothing to ¾-inch, this top course patching out many of the smaller depressions not taken care of by the binder course. A prime coat is not necessary when using AHMC.

This stretch last described had ample strength in the old surface, but was very rough and was resurfaced primarily to smooth the surface rather than to add bearing strength. This work was all done under traffic, the traffic using one side of the road while resurfacing material was placed on the other. Traffic may be permitted on bituminous concrete AHMC immediately after it is rolled without damage.

Another stretch of old and badly worn cement concrete was resurfaced with bituminous coated aggregate (pre-cote method). This resurfacing was approximately 2½ inches thick laid as follows: The old concrete surface was given a prime coat of approximately 0.15 of a gallon of emulsified bitumen per square yard. The binder course, using No. 34 crushed aggregate in the mixture, was then spread at an average depth of

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about 1½ inches, and leveled by use of a Gledhill attachment on a 12 ft. blade grader, and rolled. We then placed a wearing course of bituminous coated aggregate, using No. 6 aggregate in the mixture, with an approximate depth of 1 inch. This course was leveled by use of a Gledhill attachment and thoroughly compacted by rolling. A surface treatment was then applied, consisting of about 0.25 gallon per square yard of emulsified bitumen and coarse sand covering spread evenly over the surface. Tests of the bituminous coated aggregate used in the binder course show approximately 3½% bitumen, and in the wearing course, 4½ to 5% bitumen. We experienced some slight ravel in this section, but, as a whole, it presents a very good surface that should not cost excessively for continued maintenance.

Cost

From data kept in the field on the costs of the various methods of resurfacing described above, we find the following: Resurfacing approximately 2 inches in depth, using bituminous coated aggregate (pre-cote method) finished with a seal coat of emulsified asphalt and fine chips or sand, costs approximately 40c per square yard. The cost of resurfacing with a 2 inch binder course of bituminous coated aggregate or bituminous concrete and a ¾-inch rock asphalt wearing course is approximately 30 to 35c per square yard for the binder course and 35 to 45c per square yard for the wearing course, or a total of 65 to 80c per square yard. These costs vary some in different localities, due to the proximity of local materials or to freight rates. For the resurfacing described above, where only 100 to 110 pounds per square yard of bituminous coated aggregate were used as a binder course and 12 to 15 pounds per square yard of rock asphalt were used as a wearing course, the cost for the total resurfacing was a little under 30c per square yard.

The above is abstracted from a paper presented at the Annual Purdue Road School, January 25, 1933.

Low-Pressure "Air Tires" for Tractors

Recent tests of the new low-pressure tires on Allis-Chalmers tractors have shown them to have many advantages on a variety of work. The tires tested on the Model "U" tractor were 6.50x16 front and 11.25x24 rear. Inflation pressure in front tires was 16 pounds, in rear tires 12 pounds. The rear tires have a surface contact on the ground of 113 square inches and a ground pressure of 15 pounds per square inch.

The tests showed that with air tires much less power was required to pull the same load, with a corresponding saving in fuel. At five miles per hour, one-half as much power was required to move the tractor when equipped with air tires as when equipped with steel wheels and lugs, and this ratio generally held true at all speeds.

In loose soil or sand, the air tires performed with equal or greater success. In wet ground, the air tire performance was improved by the use of chains, and there was no difficulty with these clogging because the constant flexure of the tire dislodged the caked soil. On roads, the air tires gave greatly improved service and permitted a speed up to nearly 20 miles an hour.

No data are available on the life of these tires, but it is believed that they will give most satisfactory service, and that punctures will be very rare. Most of the above tests were carried out in connection with farm work, and the tires of one air-tired tractor showed no visible wear after 8 months of all kinds of field work.

Highway Legal Notes

Procedure to Recover for Extra Work on State Highway

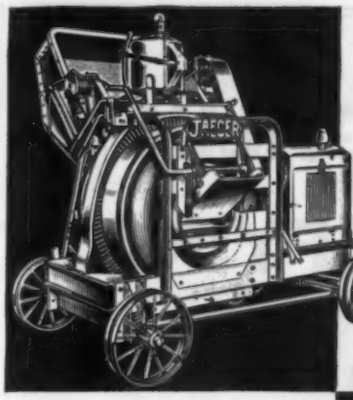
The Tennessee Supreme Court holds, Peerless Const. Co. v. Bass, 14 S. W. (2d) 732, that mandamus will not lie to enforce the payment to a road construction company, by the state highway commissioner, of an unliquidated claim for compensation for work alleged to have been performed in highway construction in connection with, but in addition to, a certain contract with the commissioner, acting for the state, the correctness of which claim was disputed by the commissioner. Mandamus is a summary remedy to be applied only when a right has been clearly established, to be performed, and it will not lie when the necessity or propriety of acting is a matter of discretion. The contractor had been paid the price stipulated, but claimed that it had been misled or misinformed as to the extent and character of certain basic conditions and was forced to incur heavy extra and unforeseen expense.

Unanticipated Cost of Removing Foundation of Bridge

In a contractor's action against a county for unanticipated cost in removing piling and cribbing foundation of an old bridge, the existence of which was not known to the contractor, the Pennsylvania Supreme Court holds, Mundy Paving & Construction Co. v. Delaware County, 299 Pa. 225, 149 Atl. 171, that the county, as regards its liability, was under no duty to disclose the existence of the cribbing and piling. The knowledge of a commissioner before he became a commissioner, of the cribbing and piling, was not knowledge of the county, and the fact that the county had installed it twenty-five years before did not charge it with knowledge which it was bound to impart to the contractor. The court said: "The law puts no affirmative duty on public officers, such as constantly changing county authorities, to search through old files for plans of existing structures before contracting for their destruction, in order to furnish prospective contractors precise information concerning the same, and particularly is this true where, as here, the written agreement for such destruction contains a provision requiring the contractor to make his own investigation."

"Fill on Approaches" Held Additional Work Under Bridge Contract

A bridge contractor sued to recover for a "fill on the approaches," which he claimed as additional work under the contract, which said nothing about such a fill and the approaches were not shown on the plan. The specifications stated that "any fill on the approaches, in excess of the materials excavated from the foundations, that may be ordered by the supervisors, shall be paid for at the price bid per cubic yard." A general statement in the contractor's proposal, to erect a bridge "ready for travel," could not, it was held, enlarge or diminish the rights of the parties, since the proposal was not made a part of the contract, and the provision of the contract to "construct and complete . . . a concrete and steel bridge," though it might raise a presumption of inclusion of the fill if standing alone, could not overcome the express provision of the contract that the township should pay for the fill. Nor could the ambiguous language at the bottom of the plan "Earth Fill 2250 C. Y." which was the number of cubic yards for which the contractor claimed as extra work. Judgment for defendant was therefore reversed, McDonald v. New Sewickley Tp., 294 Pa. 412, 144 Atl. 420.



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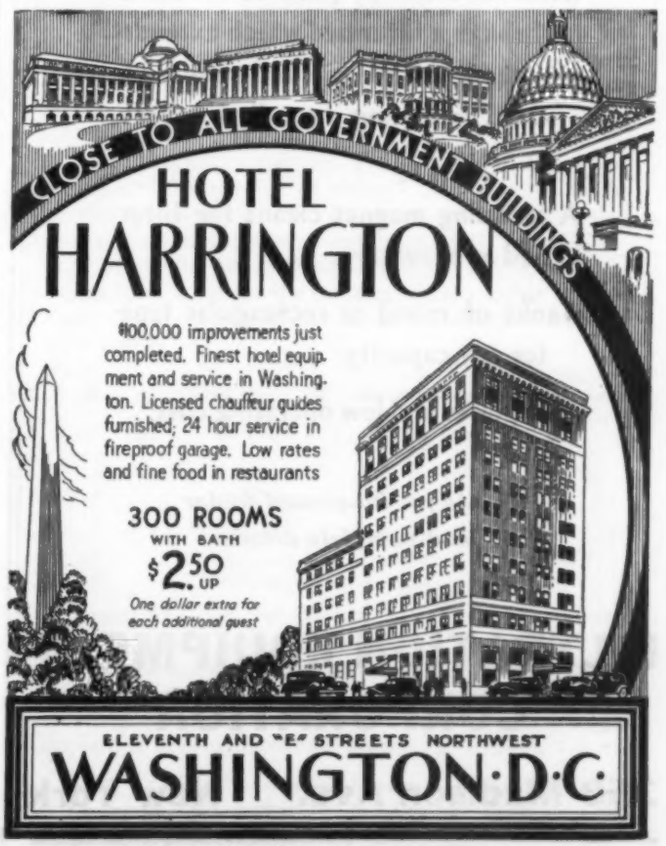

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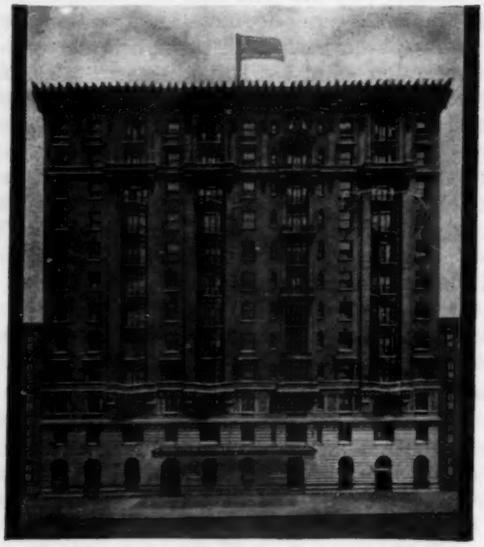

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Sanitary Engineering

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Controlling Bulking of Activated Sludge

By Robert Newton Clark
Sanitary Engineer, Innis, Speiden & Co.

The Dosing Apparatus

TESTS of the use of ferric-chloride to diminish bulking of settled activated sludge were run recently on a plant with primary sedimentation removing about 72% of the suspended solids, and activation for 7 hours, followed by clarification in two parallel tanks with inlet conduits near the bottoms and vertical flow upward over eight sets of castellated weirs. The plant was designed for a flow of 2 m.g.d., but as the rate increases beyond about 1.5 m.g.d. sludge begins to appear in the effluent, which results in the loss of a considerable amount of floc, impairing the quality of the final effluent and, in severe cases, cutting down the sludge available for seeding so that activation suffers.

While making the tests the mixed liquor leaving the aeration tanks was divided equally into the two final tanks, measurements being made over a 90-degree V-notch weir, and that entering one tank was treated with ferric-chloride while the other operated normally.

Test equipment included a V-notch weir to measure total flow into the treated tank; a Phipps and Bird solution feeder, of the floating siphon type, to control the ferric-chloride feed; an air diffuser set just below the weir to agitate violently the mixture of ferric-chloride and sewage at the point of application of the chemical; and air diffusers in the channel leading to the clarification tanks to keep the fluid in gentle motion and assist floc formation. The application of air is valuable in maintaining the iron in a ferric state, which benefits floc formation and floc weighting.

Chemical Feeding

Ferric-chloride was purchased in the lump form, and dissolved in water to form a 25% solution having a specific gravity of 1.204 and containing 2.51 lbs. of $FeCl_3$ per gallon. Two carboys feed alternately into an automatic valve, which cuts in the full container as soon as the other is emptied. From the carboys, the solution is passed through a filter of glass wool, which removes any insoluble foreign matter which might clog the feed line or siphon; and from the filter, the clear solution is fed through an adjustable floating siphon into the sewage stream. The feed can be regulated accurately to within 1%, and the adjustment was made about every fifteen minutes as the flow changed, to maintain the desired dosage. The return sludge was measured, and in reporting doses the return has been deducted from the treated flow.

Turbidity Control

A constant check was maintained by visual examination of catch samples and by measurement of turbidities in the tanks. The register of turbidities gave ample warning that sludge was starting to rise, and was one of the most valuable aids in controlling treatment. No standard turbidity rod was available, so one was constructed from a piece of shingle lath, marked in accordance with U. S. G. S. standard graduations, using for a pin a well polished fine wire brad. (This is described in detail on another page.) The following table, taken from a run on the morning of December 8, indicates the manner in which turbidity readings were used as a control:

Time A. M.	*Flow Per Tank* g.p.d.	*Turbidity-untreated tank*	*Turbidity-treated tank*
8:10	750,000	21	17
8:45	770,000	19	14
9:15	860,000	19	16
9:45	980,000	18	16
10:15	1,050,000	18	15
10:45	980,000	24	17
11:15	980,000	29	15
11:45	900,000	38	20

At noon, the flow, which had been held to approximately 2 m.g.d., was further by-passed to preserve the sludge blanket in the untreated tank; warning having been given nearly an hour in advance that the sludge was beginning to rise. When a turbidity of 35 was exceeded, a general upheaval was pretty sure to follow.

Chemical Mixing

Operation was started December 5 by feeding ferric-chloride into the stream directly in the crest of a V-notch

weir, depending upon turbulence in the channel for mixing. No air was applied beyond that point, the stream flowing smoothly into the final tanks. Doses ranged from 83 to 125 lbs. per mg. but even with the higher figure no results were evident aside from a change in color of the effluent and the sterilizing effect of the iron salt. About half the dose of ferric-chloride was carried away as soluble iron compounds.

The second day, December 6, an air jet was placed in the channel just below the point of feed to increase the turbulence and secure better mixing, and enough air was turned on in the channel to the tanks to keep the stream rolling gently, with the hope of building up additional floc and maintaining the iron in the ferric state. This operation was entirely successful, as shown by the following table.

Dec. 6	11:45 A. M.		1:00 P. M.		3:00 P. M.	
	Untreated	*Treated*	*Untreated*	*Treated*	*Untreated*	*Treated*
Sewage treated, rate	500,000gpd		750,000gpd		1,000,000gpd	
B. Coli	10,000	500	5,000	1,000	5,000	50
Suspended solids	116	38	224	94	152	24
Suspended ash	16	12	44	58	.....	5
pH	6.9	6.9	6.9	6.9	6.9	6.9
Oxygen consumed	70	35	118	33	79	26
B. O. D.	134	118	184.9	80.6	160	67.6
Color	125	50	200	50	100	50
Turbidity	100	80(29)*	200	20	70	60(20)*
Iron	1.2	1.8	1.8	1.2	1.2	1.2

*Tank reading.

Experimental Results

On December 6 dosage was maintained at 83 lbs. per mg., and total flows were handled through the plant without by-passing. In the untreated tank, sludge rose rapidly during the period when flows were increasing, settling back somewhat as the peak was passed, but still appearing as 150 to 250 p.p.m. of suspended matter in the final effluent. The treated tank, on the other hand, discharged a reasonably clear effluent, and even when sudden surges disturbed the settled sludge, enough weight was present in the floc to restore normal conditions in a short time.

The following day, after continuous night treatment, the dose was cut to 67 lbs. per mg. and flows increased up to 1.4 m.g.d. with considerable loss of floc from both tanks. The flow was cut to determine the maximum rate which could be handled with the given treatment, and the following turbidity record gives a fair idea of the results received:

Time A. M.	*Flow Per Tank*	*Turbidity- untreated tank*	*Turbidity- treated tank*
8:20	1,060,000	102	34
9:20	1,400,000	200	24
10:15	740,000	250	74
10:55	620,000	165	50
11:30	680,000	120	51
1:45	830,000	50	26
2:45	840,000	92	26
3:30	1,040,000	200	31

Between 9:20 and 10:15 the sludge rose in both tanks and flows were cut accordingly. It will be noted that the blanket settled again within an hour in the treated tank and held until flows exceeded 1.0 m.g.d. Samples at 4:00 P. M. showed the following analysis.

	Untreated	*Treated*
B. Coli	100	50
Sus. solids	204	34
Sus. ash	36	8
pH	6.9	6.9
Oxygen consumed	115	28
B. O. D.	184	74
Color	130	50
Iron	1.9	1.2

A half hour later the sludge blanket rose, and treatment was increased to 83 lbs. per mg., with a resulting decrease in turbidity on December 8 which was shown in the first table.

Discussion

The feeding of ferric-chloride requires some study and care if best results are to be obtained. Because of its corrosive nature, no ordinary metal can be used in contact with the solution, but rubber and glass or other resistant fittings must be used throughout. Mixing should be instantaneous and rather violent, lasting not more than a fraction of a minute. From the results given, it appears that some means should be provided to maintain the iron in a ferric state until a floc has formed—possibly four or five minutes. This can be accomplished by gentle aeration, or possibly by prechlorination. Operation of the tanks can be checked rapidly by means of turbidity readings, which require very little time to make, and can be used to regulate dosages. Results can be obtained with doses so small that no appreciable change takes place in the pH of the sewages, although such doses have a decided toxic effect on B. Coli in the effluent. Further study would probably show a reduction in chlorine demand in the effluent, with a possible saving in the cost of post-chlorination. The solids appearing in the treated effluent are much higher in inorganic content than those in the untreated liquor, which is an important factor.

At the plant in question, the aim of the experiment was to determine what increase in flow could be handled effectively with chemical treatment. From the data received, it is believed that the following maximum flows can be handled without serious lifting of the sludge blanket:

$FeCl_3$ lbs per mg.	*Maximum Flow Gal. per day*	*Percent of present flows*
0	1,500,000	100
67	2,000,000	133
83	2,500,000	167

The total cost of such treatment is surprisingly low. Installation of chemical handling equipment for mixing and flocculating, and other initial expenditures, would be only a few hundred dollars; and operating expenditures would not exceed three or four dollars per million gallons. For plants which need temporary or partial relief, the plan is economical and practical.

Liquor Still Gives Objectionable Taste to Castleton's Water

As a result of complaints received from the village of Castleton-on-Hudson, New York, against the presence of objectionable tastes and odors in the public water supply, an investigation was made by a representative of the Division of Sanitation of the state, which found that wastes from a liquor-still recently put in operation were being discharged into the stream used as a source of the village water supply, not far above the distributing reservoir. The evidence leading to the discovery of the still was the presence in the reservoir, and in the stream bed up to a certain point, of considerable

quantities of fungus growth not heretofore present in that water course and usually associated with sewage or waste pollution. In addition to causing the growth of fungus in the bed of the stream and in the reservoir, the wastes discharged produced an unpleasant taste in the water, which is delivered to the consumers after chlorination only.

The immediate removal of the still from the watershed was ordered.

Wytheville Water Department Uses Hypochlorite

Wytheville, Va., obtains its water supply from two springs a little over a mile apart. Water from one of these flows by gravity to a reservoir, but as this supply is not fully sufficient to meet the requirements of the town, it is supplemented about half the time by water from the second spring, which is below the level of the reservoir, which water has therefore to be pumped.

Both of these supplies are chlorinated, the former by means of chlorine gas and the latter by use of hypochlorite. The reason for using the latter is explained by R. W. Arthur, town manager, as follows:

The building used as a pumping station is an open, poorly constructed one and therefore almost impossible to heat. Another consideration was the first cost of chlorinator equipment and past experience with the cost of repair parts and general upkeep; also the rent necessary to be paid on chlorine gas containers and accounting in connection with the credits on return empties.

The hypochlorite is made into a solution in barrels or vats, which are connected to a bell which rings automatically when the supply in them becomes reasonably low. From the barrels, the solution is fed into the water by means of a Phipps & Bird feeder. This feeder is enclosed in a very small cabinet which can be kept warm by a 60-watt electric bulb. Early this year the thermometer registered a temperature of 1.2° below zero but the feeder did not freeze. Maintenance in other respects also is simple; the feeder can be thoroughly drained and disconnected in less than five minutes and replaced in the same time. Six months' experience with this method of applying hypochlorite has convinced Mr. Arthur that "any pump man can maintain and operate the feeder without interfering with his other duties in any way."

Licensing for Water Works Operators

One of the most important acts of the 15th Texas Water Works School, held recently at Temple, was the adoption of a provision whereby all water plant operators who wish to do so can obtain a qualification license. This voluntary license plan sets up three grades of operators—A, B, and C. A Board of examiners is composed of two water works superintendents, one city manager or city engineer, and one member of the Engineering Division of the State Board of Health. The scheme contemplates that all operators now employed and faithfully and properly performing their duties can probably readily obtain a grade C operating certificate. After this has been obtained, a raise to class B can be effected by taking certain minimum qualification tests, and the way is then open to getting a class A certificate.

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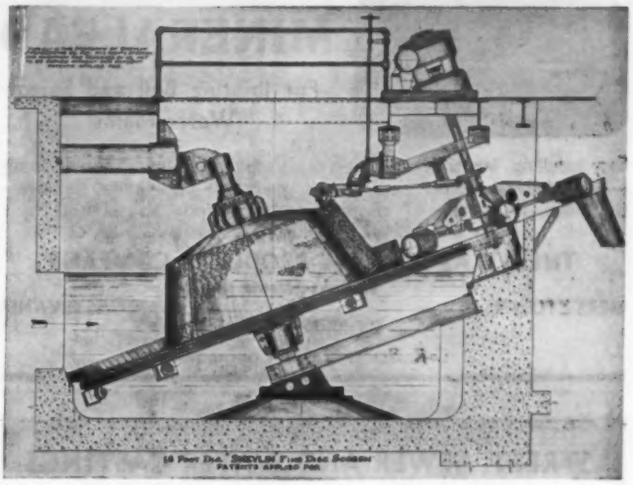

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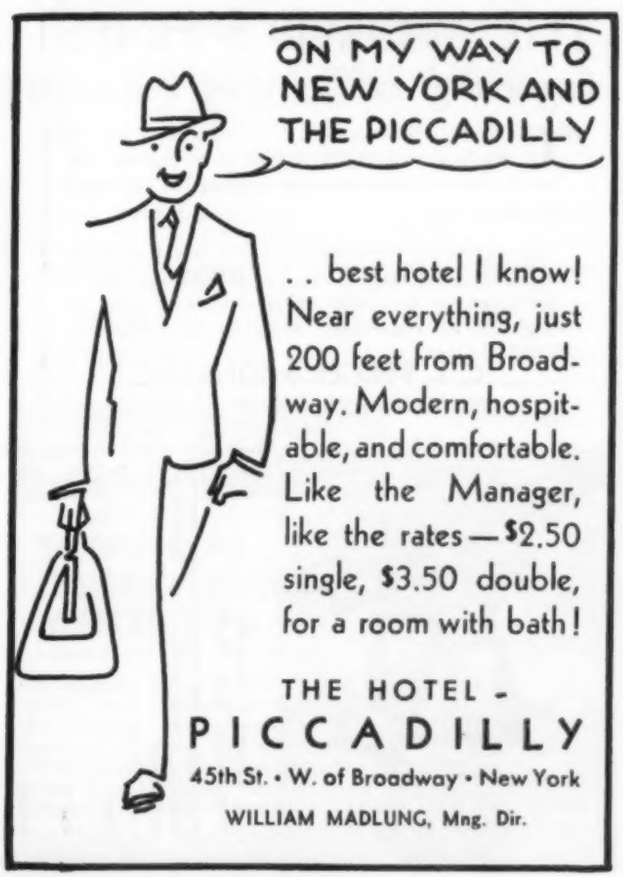
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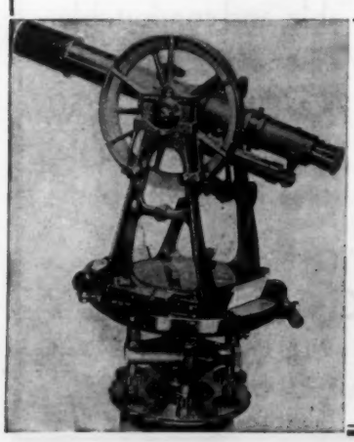

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The Water Wheel

(Continued from page 21)

the corresponding months of 1931, a color of 3.1 was obtained as compared with 3.8, with an alum dosage of 2.09 as compared with 3.48, and average filter run of 60.06 hours as compared with 53.93.

Bibliography of Recent Water Works Literature

c, Indicates construction article; *n*, note or short article; *t*, technical article.

American City, February.
1. Mountain Water for an Industrial City. (Kingsport, Tenn.) Theodore R. Kendall, pp. 44-47.
2. Eight Years' Experience with Water Mains. W. H. Waring, pp. 50-52.
3. Water Supply Project Involving Pumped Storage (Wilmington, Del.) pp. 60-62.

Canadian Engineer, January 31.
4. *n.* Deep Well Pumping Installation for the City of Guelph, Ont. H. S. Nicklin, pp. 13-14.
5. Judgment in Glenmore Dam Inquiry, pp. 15.

Civil Engineering, February.
6. Influence of Overgrazing on Erosion and Watersheds. H. H. Chapman, pp. 74-78.

Engineering News-Record, January 26.
7. *t.* Percolation Slope in Dams Measured by New Device. L. L. Meyer, pp. 109-110.

February 16
8. *c.* Shell of Concrete Standpipe Pre-Stressed by Steel Hoops. J. A. Jensen, pp. 224-225.

Journal, New England Water Works Ass'n, December.
9. Outline of the Springfield Water Works. Elbert E. Lochridge, pp. 323-326.
10. Construction of the Cobble Mountain Dam, Springfield Water Works. Harry H. Hatch, pp. 327-344.
12. West Parish Filtration Plant, Springfield Water Works. Herbert F. Salmond, 345-355.
13. Hydro-electric Power Development at Cobble Mountain in Connection with the Springfield Water Supply. Herbert A. Moody, pp. 356-364.
14. Powdered Activated Carbon in Water Purification, pp. 365-369.
15. Inch-Foot Method of Charging for Public Fire Protection Service. Frank J. Gifford, pp. 370-372.
16. Aeration in Water Treatment. Herman Anderson, pp. 373-379.
17. Mechanical Conditioning of Treated Waters. R. S. Rankin, pp. 380-388.
18. Maximum Daily and Hourly Water Consumption in American Cities. A. Prescott Folwell, pp. 389-395.
19. Quality of Impounded Water Supplies. Harrison P. Eddy, pp. 396-405.

Journal, American Water Works Association, January.
20. Typhoid Fever Epidemics from Water Supply in Germany. Hayo Bruns, pp. 1-18.
21. *t.* Hydraulics of Rapid Filter Sand. Roberts Hulbert and Douglas Feben, pp. 19-65.
22. Water Rate Structures. R. E. McDonnell, pp. 66-78.
23. Water Rates and Construction Policies in Municipally Owned Plants. L. R. Howson, pp. 79-86.
24. Water Cheaper Than Dirt. Chas. A. Haskins, pp. 87-93.
25. Storage Requirements for Northwestern Streams. Richard G. Tyler, pp. 94-104.
26. Specifications for Filter Construction. Wm. E. Stanley, pp. 105-112.
27. Influence of Standardization on Construction Specifications. Julian Hinds, pp. 113-123.
28. Indices of the Sanitary Quality of Swimming Pool Waters. M. P. Horwood, B. S. Gould and H. Shwachman, pp. 124-135.
29. Cleaning of Distribution Mains. Orla Casad, pp. 136-137.
30. How Meters Are Damaged. C. W. Winkle, pp. 138-140.

The Surveyor and Municipal and County Engineer, January 27.
31. Water Supply in 1932. Review of the Year, pp. 90-96.

Water Works Engineering, January 25.
32. Analysis of Metered Revenue Reveals Income Trends. P. J. Dishner, pp. 54-55.
33. Concord (N. H.) Water Shortage Averted by Auxiliary Well Supply. Percy R. Sanders and Frank A. Marston, pp. 58-61.

February 8.
34. Cutting Water Works Expenses. Symposium of Experiences, pp. 98-99.
35. Sparkling, Tasteless and Odorless Water of Low Mineral Content. Louis R. Howson, pp. 100-101.

Johnson National Drillers Journal, February-March
36. *c.* Setting and Plugging Open-Bottom Well Screens, pp. 2-3.

Water Works and Sewerage, February.
37. Mechanical Flocculators. John R. Baylis, pp. 43-46.
38. Bleaching Clay in Water Purification. Geo. D. Norcom, pp. 53-54.
39. Activated Carbon in Industrial Water Purification. A. S. Behrman, p. 55.
40. Loss of Head and Backwashing Velocities for Anthracite Coal in Water Filters. Homer G. Turner and G. S. Scott, pp. 66-68.

Proceedings Am. Soc. of Civil Engineers, February.
41. *t.* Evaporation from Different Types of Pans. Carl Rohwer, pp. 223-253.
42. *t.* Evaporation from Reservoir Surfaces. Robert Follansbee, pp. 256-265.
43. *t.* Standard Equipment for Evaporation Stations, pp. 266-268.

A Home-made Turbidity Rod

By Robert Newton Clark

When no standard turbidity rod is available, one can be constructed from a piece of shingle lath or a strip of 1x2, marked in accordance with the U. S. G. S. standard graduations, and using for a pin a well-polished fine wire brad.

The stick should be 48 inches long with the pin (diameter 1 mm.) 3/4" from one end. Graduations, measured from the center of the pin, are given below in inches corresponding to the given turbidities.

Turbidity	*Graduation*	*Turbidity*	*Graduation*
200	2-1/4	70	5-27/64
180	2-15/32	65	5-13/16
160	2-23/32	60	6-1/4
150	2-27/32	55	6-3/4
140	3-1/64	50	7-11/32
130	3-13/64	45	8-1/16
120	3-13/32	40	8-31/32
110	3-21/32	35	10-1/8
100	3-15/16	30	11-21/32
95	4-1/8	28	12-15/32
90	4-11/32	26	13-11/32
85	4-9/16	24	14-9/32
80	4-53/64	22	15-3/8
75	5-3/32	20	16-11/16

In use the eye is held at the end of the rod and the pin immersed in the liquid until it just disappears, always keeping the eye at the same distance from the pin. The depth to which the pin is immersed is read directly as turbidity on the scale given. All readings should be made outdoors in good light, but in neither direct sunlight nor shadows.

Mosquitoes Travel by Airplanes

By Dr. T. H. D. Griffitts

Owing to the potential danger of the spread of yellow fever from foci of infection in one country to another by means of the rapid transit by aircraft, the United States Public Health Service has carried on some exact experiments to determine how long mosquitoes will remain aboard airplanes. The results of some of these tests have been little short of astonishing.

In July, 1931, a Service representative was detailed to Miami for airplane inspection. It was soon learned that planes coming into Miami from foreign countries had mosquitoes aboard, but it was not known where they "embarked." Plans were laid, and "yellow fever mosquitoes" (Aedes aegypti) which were developed from collected larvae, were stained, so as to mark them for identification, and placed on cabin planes in San Juan, Porto Rico. After a ten-hour flight to Miami, more than 20 per cent of the stained mosquitoes were alive and, apparently, happy upon landing at Miami. This experiment, the first of its kind done anywhere in the world, put at rest the speculations of health authorities in different parts of the world as to whether mosquitoes might go on long airplane flights. It answered the question of the possible carrying of mosquitoes with yellow fever in tropical and sub-tropical countries. Other and more extended studies were made by the United States Public Health Service in 1932. "Yellow fever mosquitoes" were found to remain on one plane for more than three days and nights on a trip from the Canal Zone to Mexico, Cuba and Miami. Showing that high altitude is no barrier to the mosquito's safe journey, repeatedly mosquitoes arrived at Brownsville, Texas, from the Canal Zone via Mexico City, where an altitude of 14,000 feet, or more, was reached.

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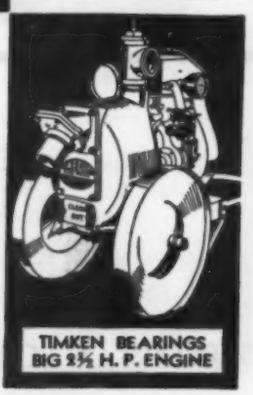

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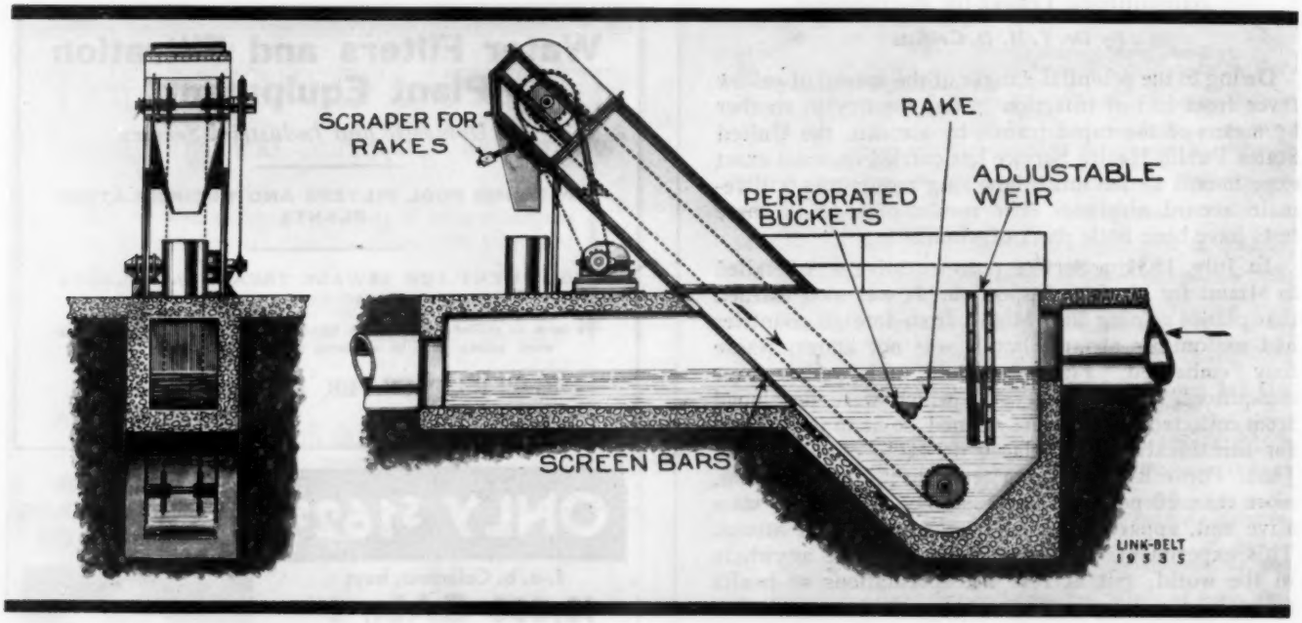

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Ace Construction Joint

was constructed—three sizes of joints (⅝, ¾ and 1½ inch air compression spaces) being installed transversely across the road at varying distances.

Although it presented a new and somewhat revolutionary method in highway construction, just 4½ minutes elapsed before the first joint was in place, covered with aggregate and properly screeded. In placing the second joint, 50 feet further on, this time was cut to approximately 3 minutes without stopping the machine or breaking the batch. And when the fifth joint was in place, the time had been further cut to only a minute—a speed maintained throughout the balance of the mile and a half of construction.

The new joint is called the Ace Expansion and Contraction Joint and is the product of the American Concrete Expansion Joint Company of Chicago. It is primarily an air-compression type joint.

The Ace Joint consists of a base web built of 26 gauge steel, crimped in the center at the bottom and flanged on both sides. A rolled strip which runs from end to end between the web provides stiffening against collapse when pouring aggregate against its sides or when tamping. At intervals of 14 inches rolled thread sockets are placed through the walls of the web.

A wood strip covers and serves as a cap, providing protection during the period of insertion and assuring a straight edge line for each slab when the aggregate has hardened. The wood strip is then removed and a bituminous filler poured in. Thickened edge construction, as specified in some states, is provided for by a shoe which slides on the ends of the joint.

It has sufficient flexibility to assume a road crown of 1½ inches without any degree of distortion. Vertical position of the joint is assured because when pegs or road pins are vertically driven through the slots they touch both sides of the wall and the bottom flange of the base web.

Ace Construction Joint

A companion unit is the Ace Construction Joint, built with an inverted U-winged top, as shown in the accompanying illustration. The vertical section of the joint has two definite corrugations of such dimensions that when the retaining pegs are driven into place they touch both sides of the slot and the outer edges of the corrugations on each side. Holes for dowel bar insertion are provided as specified. Placement of the joint in a straight line is assured by a recessing of the wing tops in such manner as to guarantee a positive accurate fitting of one into the other.

With both joints positive protection against seepage of water through the joint is provided by the wing type construction.

Munsell Concrete Vibrators

The Munsell Concrete Vibrator is the result of a study which showed that five main requirements should be considered in the dsign of such a tool. (1) the speed or frequency, (2) control of the frequency, (3) the amplitude of the blow, (4) the time of application and (5) portability.

The consistency of the concrete to be placed is the controlling factor in the frequency to be used; for wet consistencies a low frequency, for dry consistencies higher frequencies, depending on the amount of water used and the mass to be moved. The concrete for the beams usually is much wetter than that required for flat slabs, therefore, when

Ace Expansion Joint

a change of water content is made a change of frequency should be obtainable in the vibrating equipment. This is also true in the placing of mass concrete where the water gain appears on top of the concrete during a long run.

The amplitude of the blow has a bearing on the type and ruggedness of the forms to be used; a low amplitude will permit the use of comparatively light forms and result in an economical form cost, also a light blow at high frequency will not displace the reinforcing steel from its determined position.

The time of application is affected by the consistency of the concrete and the type of structure in which vibration is used. For dry concrete in floor or bridge slabs where the upper surface is subject to wear, the application should not be more than two minutes for each 10 sq. ft. of area.

The Munsell Concrete Vibrator is made in two types. Type "A," portable, weight 35 lbs., as illustrated, is equipped with a spud for vibrating slabs, beams or girders. Type "B," weight 45 lbs., is equipped with a vise clamp for attaching to vertical forms. The attachments are interchangeable.

The Munsell Concrete Vibrator is operated by compressed air, driving an eccentric rotor the speed of which can be varied from 1000 to 4000 frequencies with air pressures of 30 to 100 lbs. The rotor with an amplitude of blow of ¼ inch will not damage the lightest forms.

Further information and engineering data can be secured by addressing Munsell Concrete Vibrators, 567 Newark Street, Hoboken, N. J.

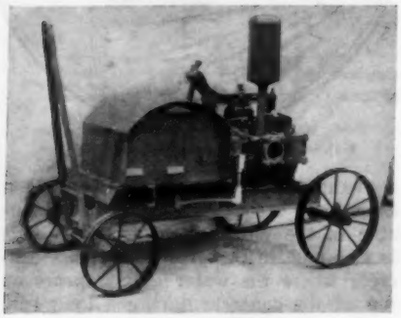
Wet-Rubbing Concrete

A new surfacer for wet-rubbing all kinds of concrete construction — the Berg water feed concrete surfacer—displaces all hand rubbing, and automatically does away with the necessity of wetting the surface with a brush.

The new surfacer can be furnished as a complete machine, or just the water feed head, known as the Model "W," may be purchased as an attachment for Berg concrete surfacers now in use. Complete details and prices may be obtained from The Concrete Surfacing Machinery Company, Cincinnati, Ohio.

Novel Electrical Control Applied to Portable Sludge Pump

To meet the unusual need of a large municipality for operating a portable sludge pump in outdoor service on either 220 or 440 volt electric current, the Chain Belt Company, Milwaukee, Wisconsin, have made a unique application of electrical controls to one of their Rex Sludge Pumps. Merely turning one handle provides proper connection with overload protection for either voltage.



Rex sludge pump with novel electrical control

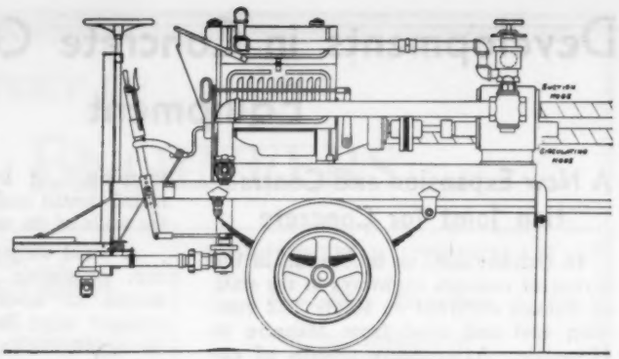
Depression Outfit Developed by Littleford

The urgent need among highway and road contractors to economize in their purchases of equipment led Littleford Bros., Cincinnati, Ohio, to develop the bituminous spraying unit shown below. It is known as Utility Spray Tank No. 101 and is made in capacities from 600 to 1200 gallons.

Low initial cost and the many uses to which it can be put, make the Utility Spray Tank a desirable piece of equipment for cities, counties and states who can (in many instances) substitute it for a more expensive pressure distributor. It is particularly useful on such work as patching, widening curves, relocating turns, repairing land slides and resurfacing ditches made by public utilities. It can also be extensively used for surface treatment and shoulder work. Very often the outfit is used as a supply tank in conjunction with a pressure distributor.

Kinney Two-Wheel Trailer Distributor

This unit, which was described briefly in last month's issue, is designed to supplement the larger Kinney distributors, and the "Junior" equipment, thus making the line complete. It has the same pump used on the large distributors, with a positive displacement of 448 gallons per minute and is engine driven. The control valves, sidewise control, spray bars, and relief valves are all similar to standard equipment as furnished for truck mounting. The trailer is provided with pintle hook for connection to the rear of the truck with flexible suction hose for connection to the supply tank and another hose to be used in connection with the by-pass or circulating system.



Kinney two-wheel trailer unit

This device makes it possible to use a fleet of supply trucks on long hauls, keeping the distributor busy on the road all the time, and thus greatly expedite the progress of the work with much lower investment cost. The trailer is equipped with balloon tires and Timken bearings and springs and is capable of applying quantities up to 3 gallons a square yard in widths of 20 ft. Catalogs describing this equipment will be available in the very near future. It is made by the Kinney Mfg., Boston, Mass.

Strainers for Centrifugal Self-Priming Pumps

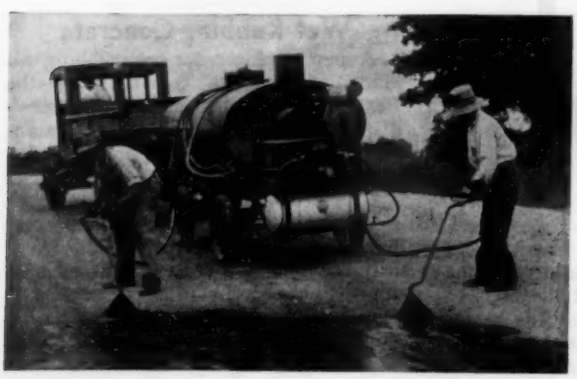
Rife Hydraulic Engine Mfg. Co., New York, has developed a strainer for self-priming centrifugal pumps, which allows full advantage of the recent developments in capacity of these pumps. Strainers are of steel, electric welded, indestructible, and have an outer suction area from 10 times the area of the hose in the 2-inch to 5 times in the 8-inch. A tube is welded on the inside of the strainer to bring the suction as near the bottom as possible, thus permitting complete dewatering of the sump while eliminating most of the usual difficulties due to clogging.

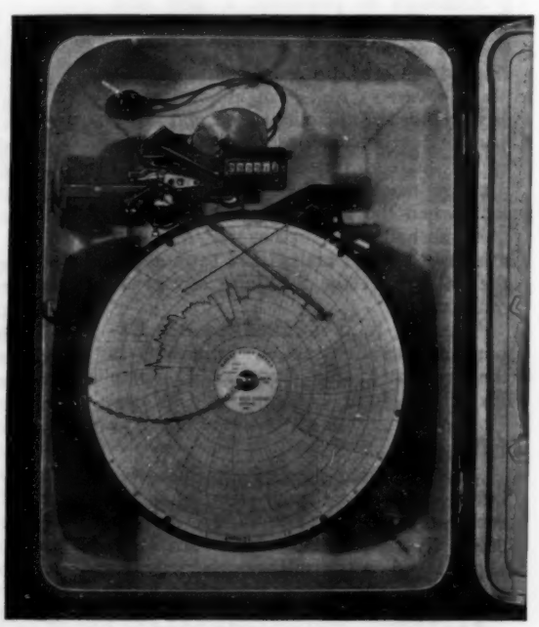
The manufacturers say this strainer was designed to overcome the difficulties of old-type strainers which easily clog and sink themselves when operating in soft mud or quicksand. The ordinary procedure of the man in charge then is to lift the strainer, take a few raps with a hammer—and no strainer. Rife strainers do not need the hammer treatment, but will stand it.

Fluid Meter With Escapement Type Integrator

An outstanding development recently incorporated in the newer line of Bailey fluid meters is the escapement type integrator. This operates in a simple, but very accurate fashion, giving the total flow in gallons, pounds or other units on a 6-figure counter, based on the prevailing rate of flow four times each minute. Full details of this device, which is shown in connection with the meter herewith, will be furnished by the Bailey Meter Co., Cleveland, O.

This company manufactures a complete line of meters for sewage treatment and water works plants. A 32-page bulletin describing the applications and uses of these meters is available.





Above: Rife Strainers; Left, Littleford utility spray outfit; Right, the Bailey Integrator.

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★ *It is a good practice to check this list regularly because descriptions of new bulletins are always being added.*

Construction Materials and Equipment

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuff," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

10. Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate. J. D. Farasey Mfg. Company, Cleveland, Ohio.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., E. Jeffry, Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Explosives

74. "Use of Explosives for Settling Highway Fills." A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Graders

76. Latest information about Galion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St. Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Lanterns and Torches

90. Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. A new line of heavy duty motor trucks and tractors for dump and commercial hauling is described in literature recently issued by the Sterling Motor Truck Co., Milwaukee, Wis.

106. "Trucks for Public Utilities," is a new illustrated booklet just issued by the International Harvester Co., 606 So. Michigan Ave., Chicago. Covers uses, types, special equipment, bodies and specifications. Sent free on request.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

113. Complete and detailed specification sheets on Road Oil and Penetration Asphalts, furnished on request by the MacMillan Petroleum Corp., El Dorado, Arkansas.

114. Complete information concerning Alabama Asphaltic Limestone will be sent promptly on request to the Alabama Asphaltic Limestone Co., Liberty National Bldg., Birmingham, Ala.

Road Machinery

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg Co., Galion, O.

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3-33

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses. The Buffalo-Springfield Roller Company, Springfield, Ohio.

134. "The Chief," a six cylinder roller of advanced design and construction is fully described in an illustrated catalog just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio. Gives complete details of the very latest development by this company.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

144. Complete information including operating ranges of General Excavators is given in Bulletin No. 3105 recently prepared by The General Excavator Co., 365 Rose St., Marion, Ohio.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport Pa.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" transits and levels are described and illustrated in a 64-page booklet. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

164. Booklet on the most popular types of Transits and Levels in general use by Engineers and Surveyors, giving full information on the sizes and styles of these instruments. Issued by C. L. Berger and Sons, Inc., 37 Williams St., Boston 19, Mass.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all-steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Road and Street Maintenance

Asphalt Heaters

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

Distributors

206. Kinney distributors of from 600 to 1,700 gallon tank capacity with heating system and the Kinney jacketed pump having a capacity of over 400 gallons per minute are described in a new catalog just published by the Kinney Mfg. Co., 3529 Washington St., Boston, Mass.

207. Kinney Junior distributors in sizes from 350 to 600 gallons with smaller pumps and engines especially adapted for light trucks are described and illustrated in a new booklet just issued by the Kinney Mfg. Co., 3529 Washington St., Boston, Mass.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way,"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 10 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214.—A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Surface Heaters

225. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Bituminous Materials

113. Complete and detailed specification sheets on Road Oil and Penetration Asphalts, furnished on request by the Macmillan Petroleum Corp., El Dorado, Arkansas.

227. "Asphalt for Every Purpose a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with 'Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

Snow Removal

Snow Fences

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

346. "The Snow Removal Problem," by W. A. Olen, Pres. and Gen. Mgr., F. W. D. Auto Co., Clintonville, Wis., is a brief booklet which should interest all who are faced with the problem of snow removal. Contains suggestions for improving the efficiency of equipment, etc.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

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are ideally adapted for your caution or warning signs, highway route markers, street or road intersections signs, etc.

Sweet's Steel Co. *Write for descriptive folder* **Willamsport, Pa.**

Industrial News and Publications

Data Books:

"Truscon Steel Liner Plates" contains engineering data, formulas for determining the proper thickness of metal to be used under various conditions, and properties of three standard types of Truscon Steel Liner Plates. Truscon Steel Co., Cleveland, O.

"Truscon Plategrid and Floorgrid" describes two new types of flooring. The former is an all-steel grating for use as open type flooring, while the latter makes an excellent wearing surface for heavy duty floors. Truscon Steel Co., Cleveland, O.

"Curtis Floodlighting" is a 28-page booklet which gives most complete and valuable data on this subject. Of much interest is the easy method of planning floodlighting which has been worked out and which makes it possible for anyone to determine the wattage and location of the units. Curtis Lighting, Inc., 1123 West Jackson Blvd., Chicago, Ill.

"Methods of Organizing and Conducting Industrial Safety Contests," a publication of the Metropolitan Life Insurance Co., New York.

"Some Recent Trends in Road Building," a series of reprints by the Flexible Road Joint Machine Co., Warren, Ohio.

"Bailey Meters for Sewage Treatment and Water Supply," has just been published by the Bailey Meter Company, Cleveland, Ohio. This 32-page bulletin covers subjects such as primary elements; sewage registers, their types and installation; air meters; special applications; water works meters; and recorders for liquid level, temperature, pressure, etc. It is illustrated throughout with diagrams, equipment pictures, and installation photographs. Copies are free.

Catalogs You Ought to Have:

Vibrating Screens made by the Link-Belt Co. are described in the new catalog No. 1362, which shows numerous improvements just made available. . . . *Road Rollers,* the very latest devlopments are described in Catalog 150, covering the Chief, a 6-cylinder motor roller. Published by Galion Iron Works & Mfg. Co., Galion, O. . . . And a catalog of *Leaning Wheel Graders,* also by Galion. . . . *Steam Turbines for Mechanical Drive* covers a wide range of data. The General Electric Co., Schenectady, N. Y. . . . *Mechanical Rubber Goods,* the Diamond Rubber Co., Akron, O., covers hose, rubber belt, conveyor belts, etc. . . . *Cement Bound Macadam,* a new secondary road pavement. Information from Portland Cement Association, 33 West Grand Avenue, Chicago, Ill. . . . *The Ideal Pipe for Water Wells* describes Republic Electric Weld pipe which uses rust resisting iron. Republic Steel Corp., Youngstown, Ohio. . . . *The Chemical Resistance of Rubber,* the B. F. Goodrich Rubber Co., Akron, Ohio. . . . *Centrifugal Pumps,* 12 to 36-inch, especially designed for irrigation, drainage and sewage, The Worthington Pump and Machinery Corp., Harrison, N. J. . . . *Cold Patching,* covering the new Cold Patch Mixer of the Chain Belt Co., Milwaukee, Wis. . . . Sweet's *Road Drags,* "A Plane Steel Story" and a complete general catalog from Sweet's Steel Co., Williamsport, Pa.

Specifications for Liquid Asphaltic Road Materials

This pamphlet contains newly-simplified specifications for Liquid Asphaltic Road Materials as recommended by The Asphalt Institute. These specifications have been developed as the result of numerous conferences with representatives of the United States Bureau of Public Roads and the various state highway departments, and supersede former Specifications Nos. 1 to 7 inclusive of The Asphalt Institute. They have been prepared to conform with the simplified scheme of analysis developed at these conferences, and cover the great bulk of satisfactory products which are now being furnished by the producers for various classes of highway treatment and construction.

Copies will be sent without charge upon request either to PUBLIC WORKS or to The Asphalt Institute, 801 Second Avenue, New York, N. Y.

Mohawk Asphalt Heater Co. Moves:

The Mohawk Asphalt Heater Co., for many years located at Schenectady, N. Y., announces the removal of its factory and general offices to a new, modern building at Frankfort, N. Y. The many advantages of the new plant will allow this company to serve its customers even better.

Calcium Chloride Association Formed:

The Calcium Chloride Association has been formed, with offices at 4200 Penobscot Bldg., Detroit, Mich. Members of the association include the Solvay Sales Corp., the Dow Chemical Co., the Michigan Alkali Co., and the Columbia Alkali Corp. Ray A. Giddings of Barberton, Ohio, has been appointed secretary, and will supervise the association activities, for which work he is especially well fitted because of his former experience in state highway work and with the Columbia Alkali Corp.

Williamsport Wire Rope Co. has been licensed to manufacture Preformed Wire Rope under the patents of the American Cable Co. It is claimed that this type of wire rope construction gives greatly increased service, and a number of other manufacturers have been licensed to use these patents.

Catalogs or booklets mentioned on this page will be sent free on request.

Personal News

Lloyd Nash Robinson, for many years engaged in engineering work, has opened an office as consulting engineer in the First National Bank Bldg., Corning, N. Y., and will practice in the power production and generation, transmission and industrial plant field.

W. McLean Bingley has recently been appointed assistant sanitary engineer of the Chlorine Institute, Inc., New York City. Mr. Bingley, who is a graduate of Johns Hopkins University, was formerly with the Dorr Co.

Nelson E. Chance, formerly district manager of the Houston office of The Brown Instrument Company, has been appointed Assistant Sales Manager, with headquarters at Philadelphia. Mr. Chance has been with the company over ten years and for seven years was manager of the district comprising Texas, Louisiana and Southern Arkansas.

Henry K. Potter, for nineteen years manager of the Municipal Department of the Kinney Mfg. Co., Boston, died at Somerville, Feb. 17. He was very well known among the highway engineers and builders. He retired from active business about a year ago.

Engineering Societies

American Water Works Association

COMING MEETINGS

March 22nd-24th, 1933—Canadian Section at the Hotel Laurier, Ottawa, Ont., Canada. Secretary, A. E. Berry, Director, Division of Sanitary Engineering, Ontario Department of Health, Parliament Bldgs., Toronto, Ont.

March 28th-29th, 1933—Indiana Section at the Hotel Anthony, Fort Wayne, Ind. Secretary, C. K. Calvert, R.R. 3, Box 976-H, Indianapolis, Ind.

April 4th-6th, 1933—Southeastern Section at Albany, Ga. Secretary, W. H. Weir, Room 138, State Capitol Bldg., Atlanta, Ga.

April 10th-12th, 1933—Florida Section at University of Florida, Gainesville, Fla. Secretary, Louva G. Lenert, State Board of Health, Jacksonville, Fla.

April 21st-22nd, 1933—Montana Section at Havre, Mont. Secretary, Herbert B. Foote, Director, Division of Water and Sewage, State Board of Health, Helena, Mont.

May 11th-13th, 1933—Pacific Northwest Section at Bellingham, Wash. Secretary, Ernest C. Willard, 720 Corbett Bldg., Portland, Ore.

International Association of Public Works Officials

The next meeting of this association will be held at Milwaukee, Wisc., September 21-23, 1933. Headquarters will be at the Hotel Schroeder. A. M. Anderson, 100 No. LaSalle St., Chicago, Ill., is secretary.

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When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the classified INDUSTRIAL LITERATURE section beginning on page 47 and order by number.

Sanitary Engineering

Activated Carbon, Aqua NUCHAR

380. For low cost removal of tastes and odors from potable waters. Used by more than 400 municipalities. For literature address Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.

Ferric Chloride

381. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Fittings

385. "6 Reasons Why Dilform Compression Fittings and Copper Tubing Are Ideal." It is leakproof, does not corrode, no deformation, vibration proof, does not restrict flow, installation cost low. Write Bailey Meter Co., 1027 Ivanhoe Rd., Cleveland, Ohio, for the price list and bulletin.

Jointing Materials

401. G-K Compound for vitrified clay sewers. MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Meters, Sewage and Water

405. Just issued. Every sanitary engineer should have a copy of this new 32 page booklet describing the applications, types and distinctive features of the new Bailey meters for sewage treatment and water supply. Sent promptly. Bailey Meter Co., 1027 Ivanhoe Road, Cleveland, Ohio.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

427. Bulletin GE31 describes Glass Enclosures for Sludge Beds in detail. Specifications, cross sections, details and illustrations shown are of value to engineers and officials. Sent promptly upon request. American-Moninger Greenhouse Mfg. Corp., Dept. B, 1947 Flushing Ave., Brooklyn, N. Y.

Sludge Conditioning

381. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Treatment

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt Co., 910 So. Michigan Ave., Chicago, Ill. and Philadelphia.

Water Development

440. Complete details of the Layne System of water development for municipalities and irrigation projects, based on deep wells and turbine pumps. Layne & Bowler, Memphis, Tenn.

Miscellaneous

Chains and Speed Reducers

607. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., gives full description of its positive drives in books No. 125, Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Transits and Levels

629. A booklet giving full information on the sizes and styles of Berger Transits and Levels will be sent promptly by C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Mass.

630. Transits and Levels particularly adapted for City, County and State work are described in a 64-page catalog. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

Wire Rope

634. Williamsport Wire Rope Co., Chicago, Ill., has issued a folder illustrating their new method of "preseating."

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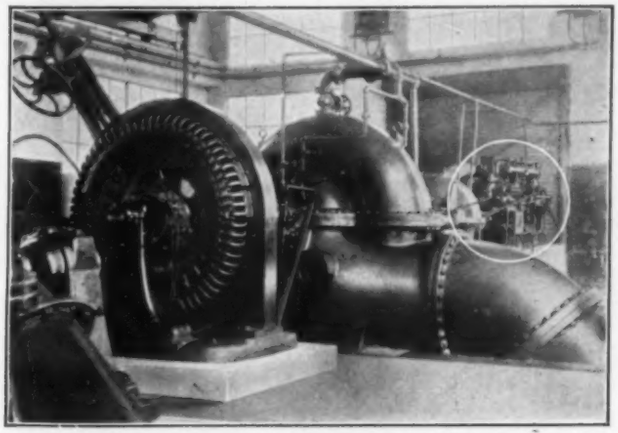

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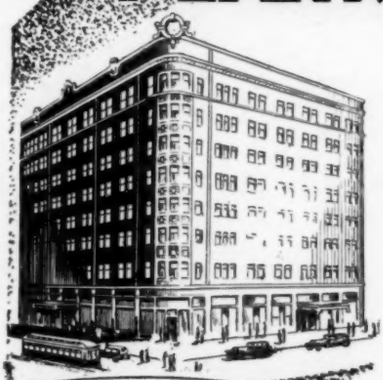

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